

POPULAR SCIENCE

MONTHLY

JULY

NOW
15¢



SEE
PAGE
51

NEW INVENTIONS • MECHANICS • MONEY MAKING IDEAS
HOME WORKSHOP PLANS AND HINTS • 350 PICTURES

AUTO-LITE

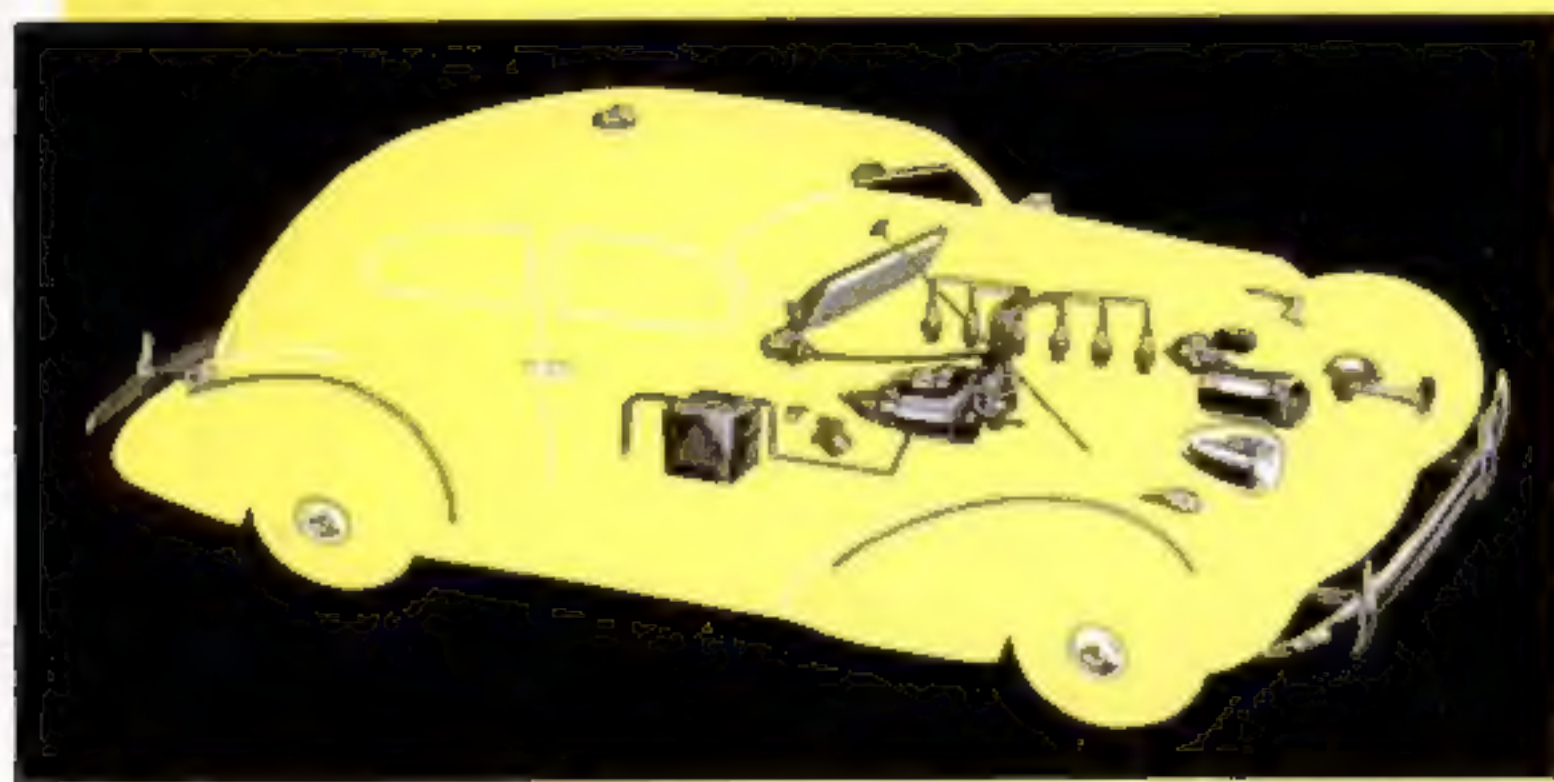
COMPLETES THE IGNITION SYSTEM WITH THE

First **SPARK PLUG**
Ignition Engineered by Ignition Engineers

Yesterday, Spark Plugs were just another accessory. Today, Auto-Lite Ignition Engineers have developed the Auto-Lite Spark Plug as a component part of the ignition system. The first spark plug built to work in perfect harmony with the rest of the ignition system—and as a result, produce perfect performance. The FIRST Spark Plug Ignition Engineered by Ignition Engineers. With such a background of Ignition experience, it is only logical that Auto-Lite Ignition Engineers should produce a basically better spark plug.

DEALERS

Be sure your customers get real spark plug performance... Stock Auto-Lite Spark Plugs now if you have not done so already. For complete information, write us, or ask your jobber salesman.

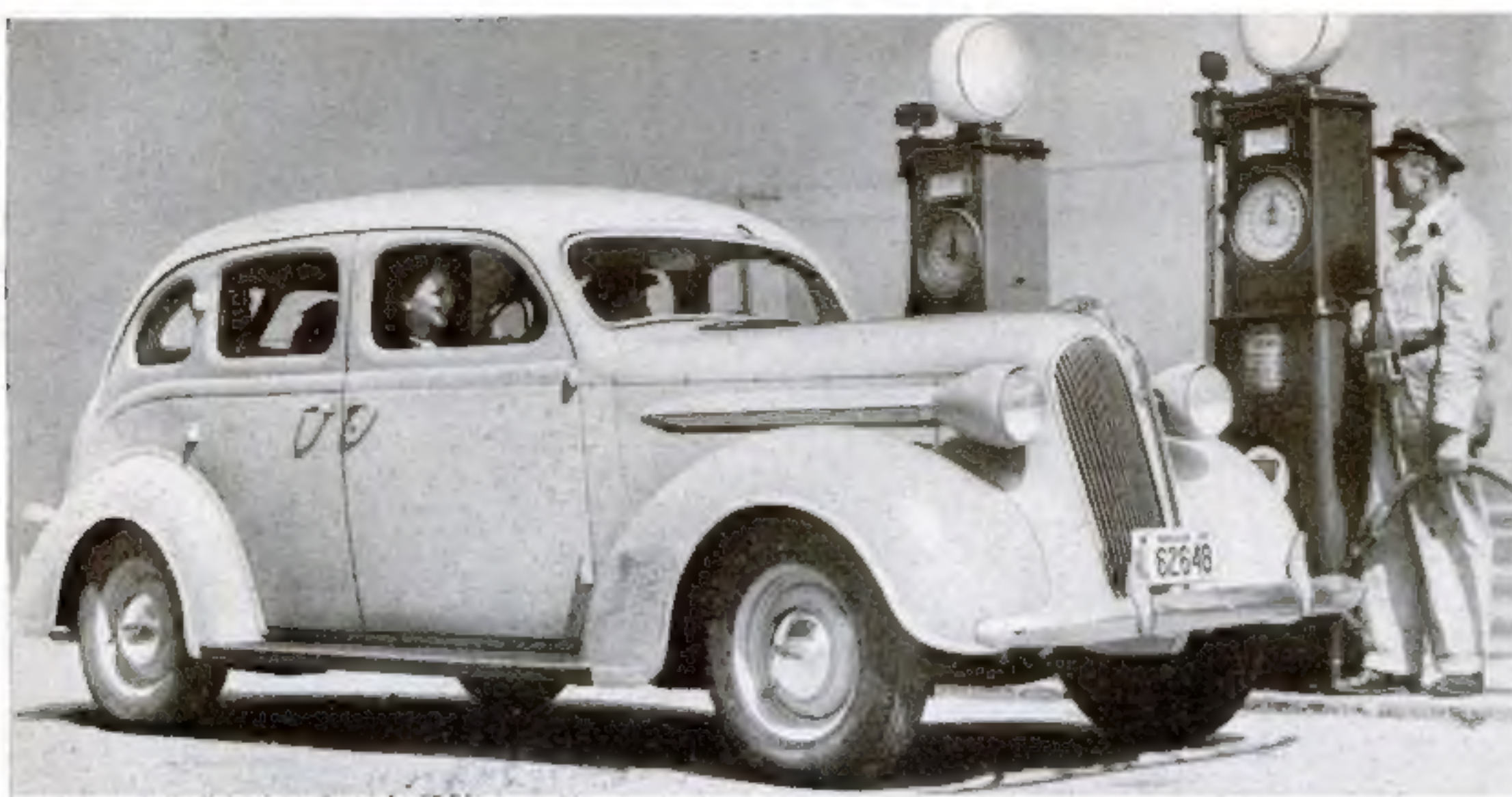


26 YEARS BUILDING STARTING, LIGHTING AND IGNITION

For 26 years, Auto-Lite has provided original starting, lighting and ignition systems for a majority of engine manufacturers. Today, the following use one or more Auto-Lite products: Allis-Chalmers . . . Auburn . . . Brockway . . . Chrysler . . . DeSoto . . . Diamond T . . . Dodge . . . Federal . . . Ford . . . Graham . . . Gray Marine . . . Hudson . . . Hupmobile . . . International Harvester . . . Kermath . . . Lincoln . . . Lycoming . . . Nash . . . Plymouth . . . Packard . . . Reo . . . Studebaker . . . White . . . Willys.

AUTO-LITE SPARK PLUGS OFFER MANY NEW, IMPROVED FEATURES
To make this better spark plug possible, Auto-Lite Engineers developed new and improved features. Konium, for example, is a new electrode superior in vital characteristics to anything heretofore available. Ziramic is a new insulator material developed and made by Auto-Lite. These, and many other features of the Auto-Lite Spark Plug insure longer plug life and greater economy, plus balanced ignition performance so essential to modern motor cars. Merchandising Division, The Electric Auto-Lite Company, Toledo, Ohio.

WAR ON WASTE ENGINEERS FIND NEW WAYS TO CUT CAR OPERATING COSTS

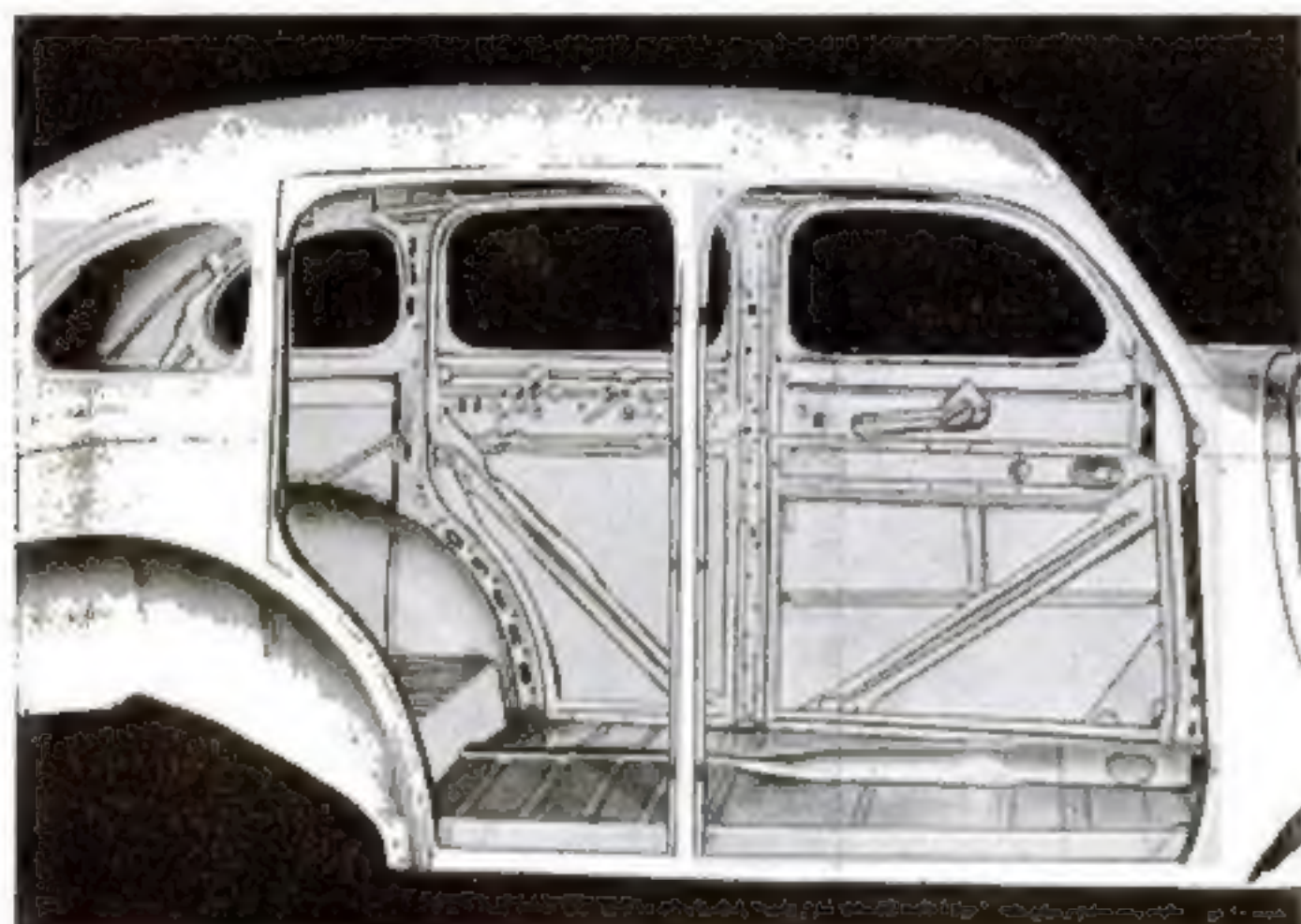


Amazing Gas, Oil and Tire Mileage...with Minimum Upkeep Costs

DOLLARS saved in operating costs...dollars saved in upkeep! Plymouth engineers have cut down all phases of motoring expense.

New engineering developments now give Plymouth long life and economy that are sensational in the low-price field. Read why Plymouth is the car that *stands up best*. PLYMOUTH DIVISION OF CHRYSLER CORPORATION, Detroit, Michigan.

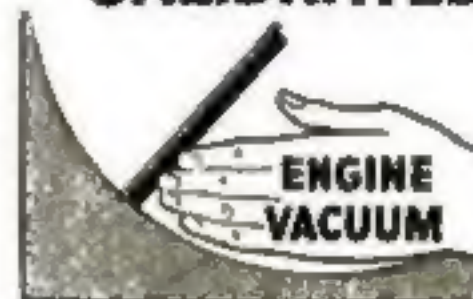
FEWER STOPS HERE—Two big ways Plymouth saves you money: (1) Plymouth owners report 18 to 24 miles per gallon of gas. (2) Full-length water jackets, directional cooling, four rings per piston and an oil filter keep Plymouth oil bills down!



THIS BODY IS ONE SOLID STEEL UNIT

Steel pillars, panels, floor...one-piece steel top...sides and rear...are all welded into a single, rigid unit. The entire body is pillowed on rubber, and sound-proofed with five different kinds of insulating material. It's the safest, quietest, longest-lasting construction you'll find on any low-priced car built today.

"CALIBRATED IGNITION"



Vacuum is "free power." It runs windshield wipers, and, in Plymouth, gives you Calibrated Ignition.

Calibrated Ignition is simple. Vacuum from the manifold increases or decreases with engine load. In Plymouth, this vacuum is made to control the spark adjustment by direct connection. Thus, the engine actually "feeds itself" proper spark.

Result—at all times...under all conditions...the spark is at maximum efficiency! That's why Plymouth's 6-cylinder, "L-head" engine delivers compression of 6.7 to 1 without needing a premium gasoline! And also why you save money!



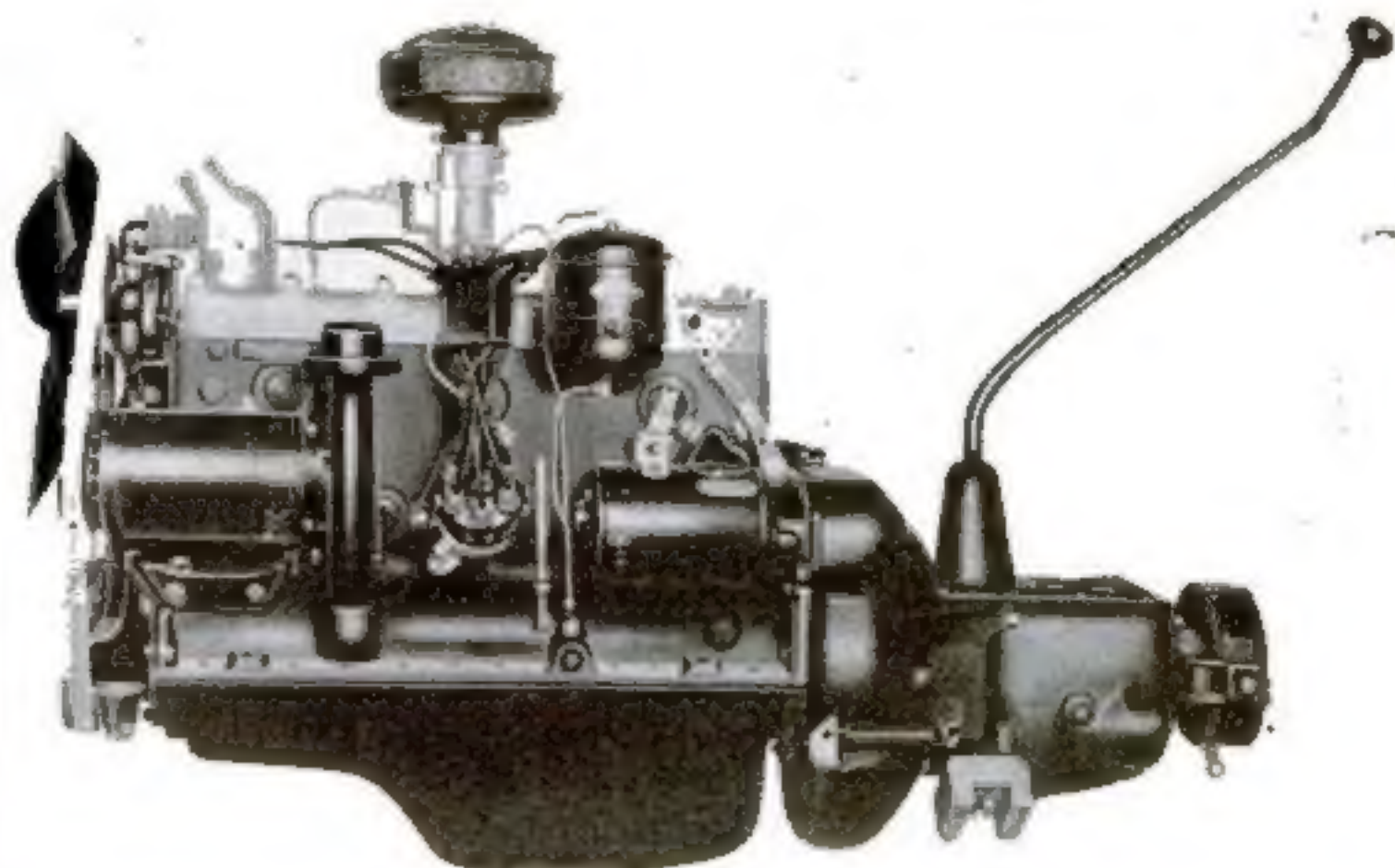
SAVINGS IN BRAKES—Plymouth's double-action hydraulics (left) distribute equal pressure to the entire braking surface...give smooth, even stops with a minimum of effort. This self-equalizing action means *surer control*: there's no grab or jerk...*"diving stops"* are eliminated. This also adds to the life of your tires.

TUNE IN MAJOR BOWES' Amateur hour—Columbia network, Thursdays, 9 to 10 p. m., E.D.S.T.

PLYMOUTH HAS THE HIGHEST RESALE VALUE OF "ALL THREE" LOW-PRICED CARS

A check-up on used-car ads in city after city shows that used Plymouths are bringing as much as seventy-five dollars more than competitive used cars. Here is direct dollars-and-cents evidence of the public's discovery that Plymouth is the car that stands up best.

EASY TO BUY—Plymouth is priced with the lowest...and offers convenient payment terms. The Commercial Credit Company has made available—through Chrysler, De Soto and Dodge dealers—terms which make it easy to buy a new Plymouth today.



FAMED FLOATING POWER mountings support the big, 6-cylinder "L-head" engine in perfect balance. Cushioned on rubber, the weight of the engine itself acts to counteract the forces of vibration.

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Soundproof room, General Electric laboratory, Schenectady

How Science Conquers Noise

NO echoes roll, no outside noise intrudes in this chamber where G-E scientists calibrate sensitive instruments that measure sound.

These instruments, in soundproof rooms, are used to get rid of noise. They measure the whispers produced by fans. Research like this makes possible the development of new fans—fans that are quieter and more efficient—that will deliver fresh air to your offices and factories—that will provide you with year-round comfort through air conditioning.

Research on sound is helping to reduce the

level of noise in shops and offices. Electric instruments, perfected in General Electric laboratories in Schenectady, trace elusive sound to its source. They locate vibrations that produce distracting rattles and squeaks. They investigate the causes of sound in machinery—make possible the development of machines that hum instead of roar—reduce noise and costs.

All over the country people are protesting against unnecessary noise. And General Electric scientists, enlisted in this same crusade, are helping to make possible for you quieter, more comfortable living and working conditions.

*G-E research has saved the public from ten to one hundred dollars
for every dollar it has earned for General Electric*

GENERAL  **ELECTRIC**

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SYMBOL OF SERVICE

This country's good telephone service did not just happen. It has been made possible by the organization and development of the Bell System.

BELL TELEPHONE SYSTEM



Our Readers Say



Did an Intruding Comet Cause the Ice Ages?

THE mysteries of the ice ages have long excited my interest, but in talking with various well-informed experts, I have found them quite perplexed by the problem. The evidence seems to indicate that the various ice ages came on the world suddenly, and I offer this theory to explain how they might have come about: It is generally conceded that some comet, known or unknown, in its path about the sun, might come near the earth's orbit. My theory is that such a celestial interloper, in ages past, approached closely enough to the earth to exert a considerable tug on our magnetic pole—enough to tilt the earth's axis suddenly to a new angle. This would displace the geographic poles to form the ice caps at a new location, and they would continue in this state until the accident of a closely approaching comet is repeated. My idea is based on a strong magnetic attraction, and accounts for the sudden occurrence of the phenomenon at widely separated times, explains the broad, washed-out valleys due to the rapid melting of the ice caps, and, unfortunately, suggests the possibility of the calamity's recurrence.—W.F.D., Cleveland, Ohio.



Welcomes Silencers for Dogs—and for Dog Owners

RECENT issues of your excellent magazine have convinced me that the world is becoming a better place to live in—at least, for those of us who have dog-keeping neighbors. I read with pleasure, a few months back, of the painless operation by which a canine bark can be amputated, and now your June issue brings welcome tidings of a "silent" whistle for use by those enthusiasts who insist on romping outdoors with their pets in the early morning. Now all I have to do is to save up enough money to send the German shepherd next door to the hospital, and present his master with one of the whistles. There ought to be a law making it compulsory for city dog owners to show this much respect for the ears of their neighbors.—A.L.B., Newark, N. J.

Pigeon Raising and Fencing Are His Pet Subjects

How about some articles on fencing? I think a series on this sport, telling how to make one's own foils and masks, should interest a good many readers. Another thing I would like to see is more information about pigeons; how to raise them and teach them tricks. I enjoyed the article you had on this subject some time ago, and would like to read more.—E.A.S., Chicago, Ill.



Nebraska Conservationist Has His Ire Roused

OUR friend, I.A.L., of Dearborn, Mich., has attempted to belittle the soil and water-conservation practices now being recommended. If I.A.L. would plod through the fields after one of our Nebraska rains and observe the erosion on the cultivated fields, while the virgin prairies remain unaffected, I am sure that he would revise his opinion. If he could talk to some of the old-timers of this country and learn how streams that at one time flowed steadily throughout the year are now dry canyons except after storms—when they become raging torrents—he would believe that cultivation accelerates run-off. If I.A.L. could stumble into some of the gullies that have formed since unwise farming has been practiced, the dangers of erosion would be forcibly called to his attention. A little first-hand study of the situation is all he would need to make him as enthusiastic a proponent of conservation practices as he is now a critic.—J.T.P., Hebron, Nebr.

This Is the Exception That Proves the Rule

If you will pardon my saying so, there seems to be something fishy about the article on photographing the Quintuplets, in your February issue. You say that Fred Davis has a monopoly on photographing the Quins, and then you show him in the same picture with them. He couldn't have taken that photograph, could he?—R.K., Appomattox, Va.



Getting All Steamed Up Over Nature of Steam

I, in my turn, am glad to be able to correct E.R., who corrected E.E., who corrected two other readers regarding the visibility of steam. According to his dictionary, "steam is the mist formed by the condensation of water vapor;" but he does not add what my 1937 dictionary says in addition to this—"... water vapor—popularly so called." Another dictionary that I have says, "Steam is invisible, and is to be distinguished from the cloud or mist which forms in the air." So it seems that E.E. is right in saying that steam is invisible.—M.L., Fremont, Nebr.

That Plowing Problem Put Furrows on His Brow

B.Z., of Roundup, Mont. has my sympathy in respect to his plowing problem, for I, too, am unable to solve it correctly. The closest I can figure is to an area of 2,331.368 square rods (14.5710 acres) of plowed field, whereas the unplowed field measures 2,331.36396964 square rods. There is a difference of 0.00403036 square rods between the two plots, and for this difference I am truly sorry. However, the

true answer lies somewhere between 68.284 and 68.285 rods for the outside measurement of the plowed square field.—J.S.A., New Bern, N. C.

Wonder What Dictionary This Came From

IN LOOKING over a recent issue of your fine, informative magazine, I noticed this heading, "Come On and Tell Us What Science Is." Such ignorant people! Science are those things that say, "No Parking," and "Keep Off the Grass"!—N.C.L., Utica, N. Y.

THAT MAKES ME A SCIENTIST!



Chemistry Fan Would Analyze His Own Store of Knowledge

DURING the five years that I have been reading your magazine, I have never found any fault with it, but after waiting patiently for someone to suggest this one addition, I decided to do it myself. The chemistry page is my meat, and I think it is swell, but I think the author should print some questions so that we amateurs could try answering them, and know how we stand. The answers would be published in a following issue so that we could check our results.—J.S., Brooklyn, N. Y.

Homemade Oscilloscope Met Long-Felt Want

Good for you! I hope you have more fine articles on radio. That recent one on the homemade oscilloscope filled one of my long-felt desires. Now I would like to see something on how to use an oscilloscope as a monitor for an amateur radio station.—B.A.K., Hammond, N. Y.

"Fore-Topgallant Stunsail" Is Over His Head

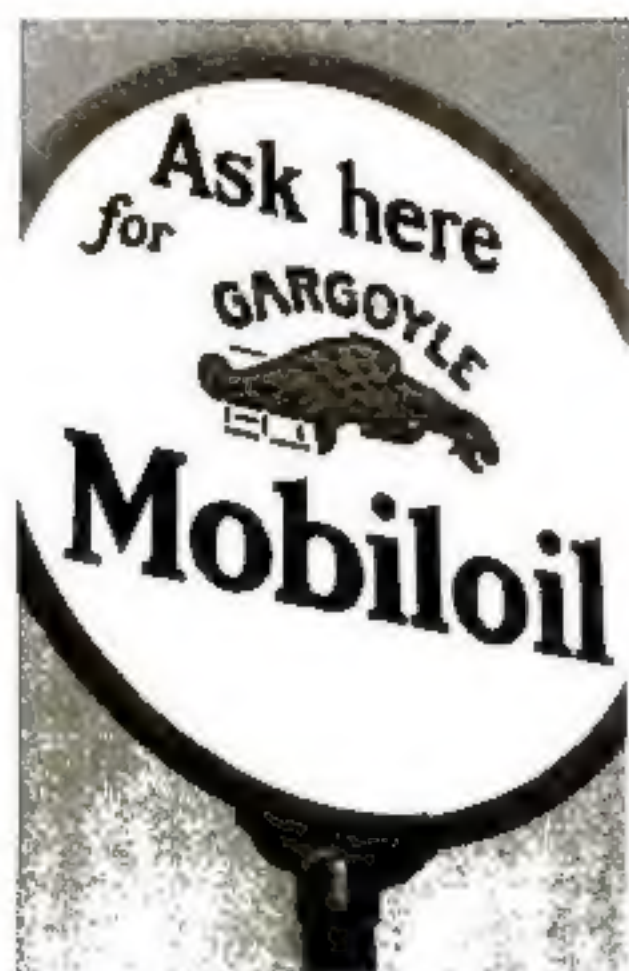
WHILE I am interested in ship models like the ones you describe from time to time, I can't fathom the high-pressure nautical terms used in describing the construction. Why not give beginners a chance, and publish a pamphlet or diagrams with these parts named so we can tell which is which? —H.H.D., Whitewater, Wis.

PORT IS WINE AN' A SHOT O' RUM IS A DRINK, LET'S SPLICE THE MAIN BRACE!



Asks Clearer Definitions Of Scientific Terms

FOR the benefit of readers who are not acquainted with the scientific and popular names of many of the chemical substances, plants, and minerals men- (Continued on page 8)



WORLD'S

LARGEST-SELLING

SUMMER OIL



**MORE FOR THE MONEY—
THAT'S THE REASON MORE
MOTORISTS BUY MOBIL OIL**

**THIS WEEK... Next Week...
Every Week...** all through the
stifling, hot summer...

More motorists will drive in and
ask for summer Mobiloil than for
any other motor oil!

Why? We'll tell you. Because
Mobiloil is absolutely the best
oil to withstand the terrific, film-
cracking summer heat of your
car's crankcase!

Impurities that defy ordinary
refining methods are removed by
the famous Clearsol Process. As
a result, Mobiloil is cleaner,
tougher... gives longer mileage!

Fill up with summer Mobiloil,
today—finish out the summer
with a sweeter-running car!

MOBIL OIL AND MOBIL GAS
SOCONY-VACUUM OIL COMPANY, INC.





This Amazing Sponge **FREE** *with every pint can of* **No. 7 POLISH**

WE make this generous offer so that new thousands of car owners will try No. 7 Duco Polish immediately, and see how greatly it improves the appearance of the car. You should use No. 7 Polish on new cars as well as old. It keeps new cars beautiful and restores the color and lustre of old finishes dulled by grime and Traffic Film.

Now we offer a Du Pont Cellulose Sponge (25c size) FREE to everyone who buys a pint can of No. 7 Polish. (Offer good in U. S. only.) This sponge, created by du Pont chemists, is ideal for bath and household cleaning, as well as for the car. See your dealer **WHILE THEY LAST!**

**GRIME DOES NOT PAY
... USE No. 7**

OUR READERS SAY

(Continued from page 6)

tioned on your pages, I would like to suggest that alongside the currently used name you print the scientific term. Or, as an alternative idea, you could, in such sections as the monthly chemistry article, publish a separate list of each substance mentioned in the story, translated into precise scientific terms so that anyone could identify the chemicals positively.—R.A.A., Mexico City, Mexico.

Anyhow, This Isn't the Path of Least Resistance

ANOTHER problem that might make The Our Readers Say fans sharpen up their pencils (and their wits, as well) is this one: In a field that measures fifty by 100 feet, there is a path, four feet wide, running from corner to corner. One edge of the path meets one corner of the field, and the other edge meets the diagonally opposite corner, as shown in the diagram. The owner of the field wishes to pave the path. How many square feet of paving material does the man need?—H.J.D., Putnam, Conn.



Wanted: Hints for Setting Knife's Broken Bone

BEING a habitual buyer of Popular Science, I am glad to have found a reason and time for writing to you. I have been buying your magazine for over seven years, and the most striking thing in the whole book, believe it or not, is your cartoonist! I wish to bow to him and his witty drawings. Just what does he look like? I get a kick out of reading the various letters asking for this and that, and I notice that many of the readers are adept at solving problems. Perhaps they can help me with mine. I have an expensive hunting knife on which a small part of the bone handle is broken, leaving the rest loose and jagged. Can anyone come to the rescue with a method of patching the handle? I use the knife quite a lot, and the forthcoming (I hope) repair must be strong.—A.L.S., New York City.

Wants to Talk Back To Radio Announcers

I HOPE that in the near future you will publish a short article on how to make a simple microphone for beginners; one that could be used on any radio set. Also, I think an article on the workings of a commercial broadcasting system would be of wide interest. Perhaps one of the Our Readers Say contributors could tell me how to make the kind of "mike" I am after.—E.C., Middletown, N. Y.



Building Paper Makes Inexpensive Darkroom

THIS idea may be of interest to the large number of your readers who pursue photography as a hobby. Not so long ago, I got tired of not having a darkroom that I could really call my own. I wanted something better than a converted bathroom, kitchen, or laundry, but the greatest obstacle I had to overcome in building one was the cost of material. The price of the wall board that I needed for covering the walls of the room was beyond my

means, so instead of using this type of material, I got a roll of heavy building paper. This is very heavy, strong, and absolutely light-proof; best of all, it costs only about a cent a foot. I built a framework of light roofing lath, and covered it with this paper. The joints, I found, could be made with either a folded or plain lap joint, and the sheets are held together with heavy gummed wrapping paper. I hope this idea will prove useful to others who, like myself, have to keep expenses down to a minimum.—C.W.M., Jr. Reading, Pa.

Body Heat Makes the Flies Evade Your Swatter

IN A recent issue, we are told that it is difficult to catch the common house fly napping because he has thousands of eyes. I have always been led to believe that, with all his eyes, a fly has very poor vision indeed, but that his other senses are highly developed. The fly cannot see your hand as it approaches to swat him, but he does feel the heat emanating from it, and the temperature warns him of danger.—R.W.H., Melbourne, Australia.

An "Old Bill" Fan Wants More Machine-Shop Articles

HAVING read your interesting and instructive magazine for sixteen years, I have a holler to make. Mild, mind you, but still a holler.

You used to have articles on machine-shop practice, but in recent years, nothing on this subject has appeared, except Old Bill's shop hints, which I always find helpful. How about giving us "nut busters" a break by writing an article on shop experiences once in a while?

I know that you probably get plenty of letters like this one, and I know we all can't get what we want—but, at least, we can let you know. I plan to buy your magazine another sixteen years—at least, until you start printing love stories in it.—J.R., Jerome, Ariz.



"Wherever You Stop at Night, You Have a Home"

EDWIN TEALE's interesting account of his trailer trip reminded me of an amusing definition of the "home on wheels" which I heard recently. While driving north from Florida this spring with our trailer, my wife and I pulled up for lunch under a tree beside the road in South Carolina. As we were eating, an old ducky and his wife walked past, and the woman kept craning her neck at our trailer. Evidently, she had never seen one before, and the old man explained it to her. "That," he said, "is a house that rolls along the road, and wherever you stop at night you have a home." That struck me as being about the best description I have ever heard of the new travel fad.—J.M.A., Detroit, Mich.

He Would Have Automobiles Look Where They're Going

PERHAPS some reader can answer this question: Why don't automobile manufacturers equip their cars with headlights that will turn with the front wheels? This would be a great help, especially in driving on winding, mountain roads, where the present type of lights shine away from the highway at least half the time. Surely the cost of production would not hinder the regular (Continued on page 9)

OUR READERS SAY

(Continued from page 8)

use of this type of headlight. I would like to correct H.F.G.'s criticism of M.T.L.'s statement that the range of man's eyesight is only thirteen miles. H.F.G. takes the stand that if vision were so limited, none of us could see the sun, stars, or moon. Well, H.F.G., you can't see the heavenly bodies themselves, anyway—all you see is the light that they reflect or give off.—B.T.L., Alameda, Cal.

Another Shooting Enthusiast Wants More Gun Articles

OCCASIONALLY you have had articles on guns, and I enjoyed them very much. I should like to see more, especially pertaining to .22, .25, and .30/30 caliber rifles and their ammunition. Since the care of a rifle is of utmost importance, articles on cleaning materials and methods would be most welcome. Among other things, I especially enjoy the articles on chemistry and on microscopy.—R.B., Cleveland Heights, Ohio.

IF I COULD JUST GET A SHOT!



Asks For the "Low-Down" On Giant Industries

A FIELD that you have not yet covered occurs to me, and I suggest the idea for what it is worth to you. Why not publish articles on the scientific processes used in various industries? I have in mind the use of photographs and diagrams to show how one of the large industrial corporations in each field takes raw materials and converts them into articles of commerce. This would be handled, of course, from a popular scientific viewpoint. Another possibility for future articles would be interviews with famous university scientists, giving these men an opportunity to speak for themselves about their own work. I think this would bring to the readers' attention a great deal of fine research that has received too little publicity.—T.H.S., Jr., Lombard, Ill.

Mayonnaise Jars Will Keep Nuts and Bolts Fresh

WHY not suggest to A.W.B., of Buffalo, N. Y., that he can solve his nut, bolt, and screw problem by using glass jars? These make a neat and convenient way to store small pieces of hardware, and the big advantage is the fact that the jars, being transparent, need no labels, because it is easy to see just what they contain. This also makes it possible to keep a check on one's supply of the different screws and nuts without opening each jar. Screw-on tops are waterproof, and will keep iron parts from rusting in damp cellars.—L.C., Cossackie, N. Y.



Frank Zaic's Airplanes Please This Reader

WHY don't you devote a special portion of the magazine strictly to model-airplane construction? Practically all of your younger readers, as well as many of the older ones, enjoy making models, and they should welcome such a department. I have made two models from Frank Zaic's designs in past issues, and both of them are exceptionally good fliers.—K.F., Salt Lake City, Utah.

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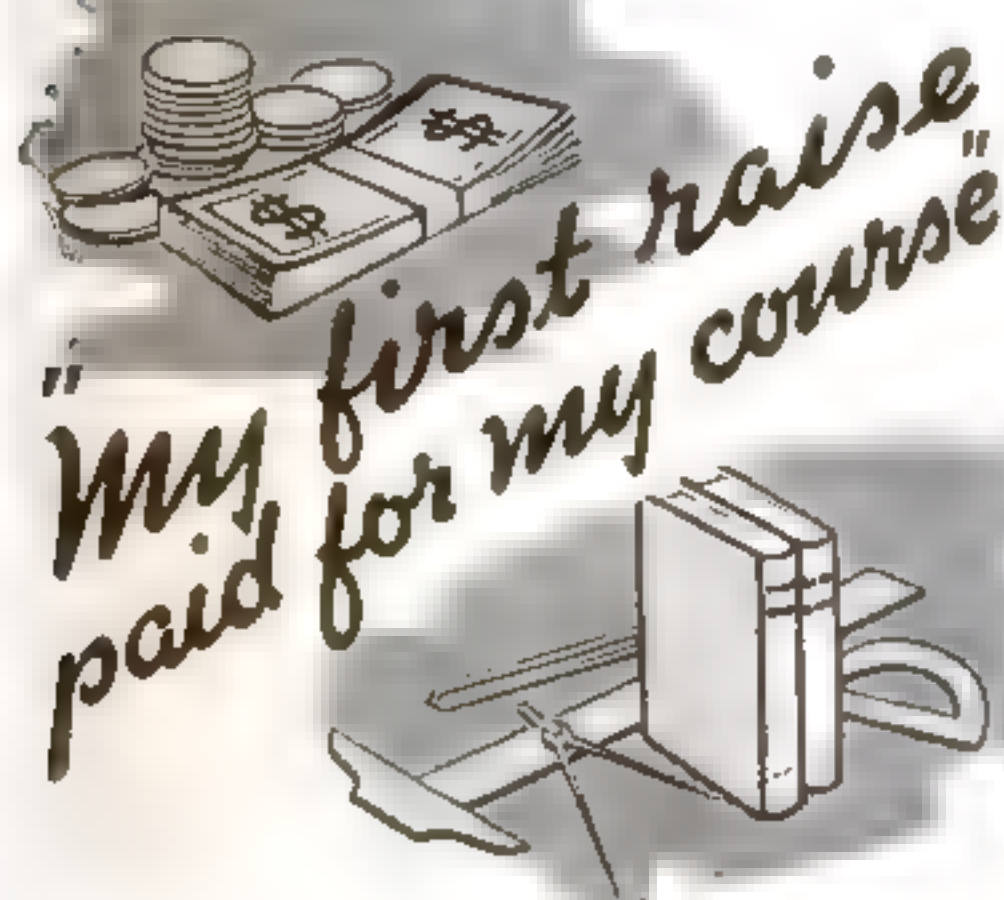
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Only letters from bonafide home study school students will be considered and these must contain the name of the school and the name of the company, or companies, for whom you have worked since graduation. (Names, however, will be deleted from the letters when published.) We also want to know the kind of course you took and the type of position you have held. Your own identity will be kept anonymous, if desired.

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"THE COURSES WERE TOUGH, BUT . . . !"

In my boyhood days I always dreamed of some day becoming an engineer. I loved mechanical things such as watches, machines, and engines. I loved to see wheels and gears go around, and I was always taking things apart to see what made them go.

After finishing only two years at high school, my father decided that it was time for me to go to work and help support the family. I did not like this but father's mind was made up, and that was that. He got me a job at the paint factory at which he worked. My job here was to clean bottles, which were used to hold samples of varnish and paints. The work was not to my liking and, in addition, my hands were burned from the solution which I used to clean these bottles.

I told my father that I could never learn anything about engineering here—washing bottles—but this did not move him at all, so I thought the only way out was to get lax and disinterested in my work. This I did, and a few days later I was fired. Well, dad saw that I was determined to have my way, so he said "Son, follow the road that you want to

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travel. I will not hinder you in the least bit, but you must work."

I knocked around on other jobs while making up my mind what to do. I finally decided that there was only one road left open which would bring me to the goal I had in mind. This was to study at night and at the same time get experience along engineering lines.

With this in mind, I applied at the _____ Company, makers of turret lathes and telescopes, for a job as machinist and toolmaker's apprentice. The wage was very small, but I was happy because here I had an opportunity to study and work. But while with this company, I soon realized that my appetite for study was not satisfied, so I promptly enrolled with the _____ School and began their course in engineering. Here at last was more information on engineering subjects. After four years I completed my apprenticeship, and became a machinist and toolmaker. I left here and did many jobs at other shops to obtain more information and experience.

My next step was to get work as a draftsman. This was accomplished when I received a job at the _____ Company as tracer. I stayed here for only one year because an opportunity came my way at which I could put all that I had studied to use. This chance was to work as assistant to an experimental engineer who was connected with the _____ Company. The work consisted of following a new idea in regard to carbon brushes, from start to finish, including machine shop work, laboratory and drafting or designing, as well as labor. I worked for this company for four happy years. But happiness did not last long. My division was moved out of town, and on account of my family I could not go along with it.

This, however, did not stop me and I received employment with another concern which makes heavy forging machinery. Here my work consisted of tracing and some minor detailing. Then along came the depression and I was let out, due to no fault of mine.

But during the depression when others were moaning over their losses, I kept right on and finished my course of study. I had a little money left and this I used to pay for some more study. I took another course, this time in internal combustion engineering.

Through 1933-34, I did odd jobs such as painting, labor, selling—as a matter of fact—anything that I could work at and earn money.

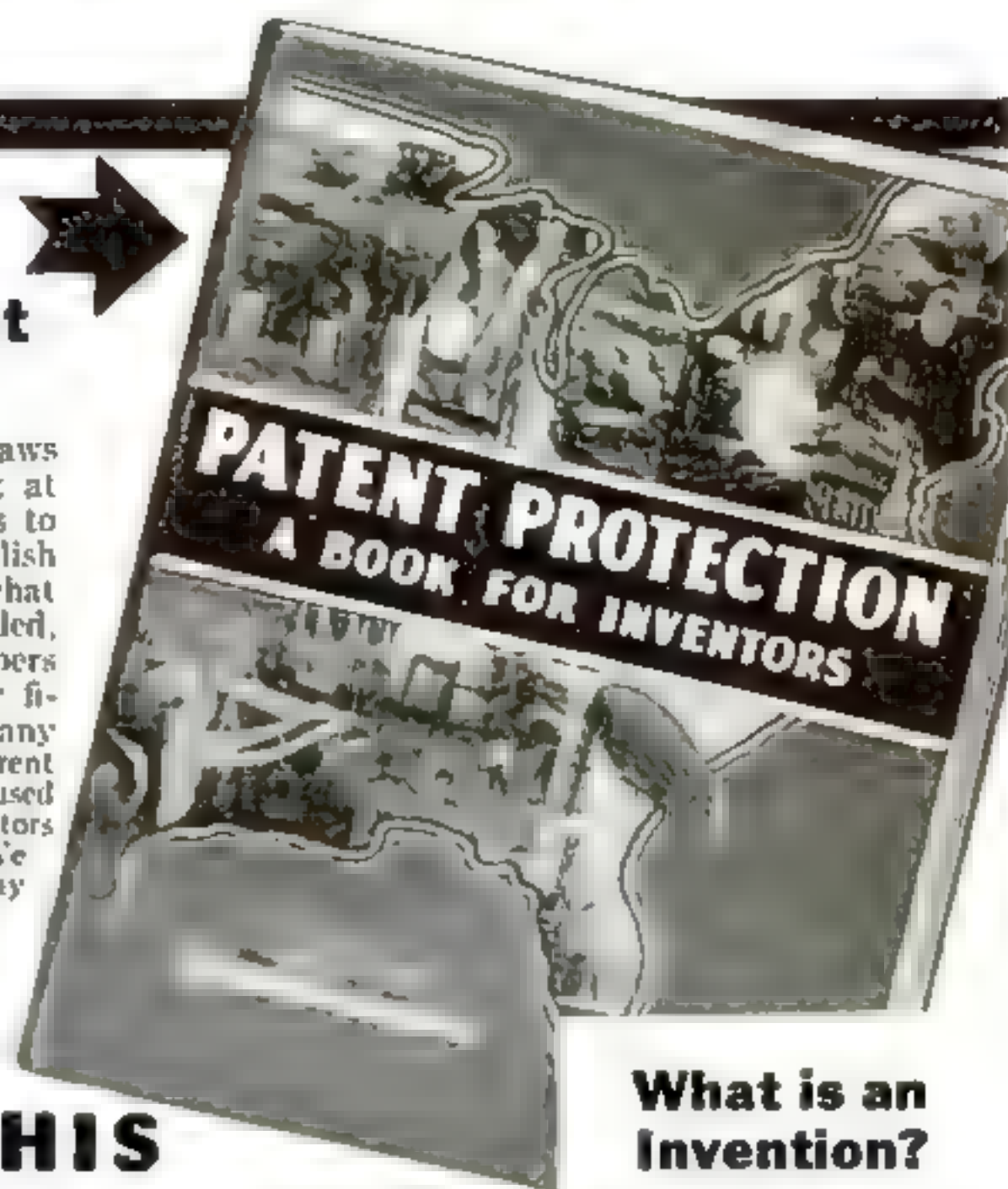
In 1935 I met a girl, and eight months later we were married. Jobs began to open up and I again received a job as draftsman with the _____ Company, makers of ex-ray equipment. This job only paid \$22 a week, but this was better than nothing. I hurried and finished my course, then at last I again got a better job, and one which paid more money.

This job was as a detailer with the _____ Engine Company, makers of marine diesel engines. After only one and a half years here, I am proud to say that promotion came mighty fast. At the present time, at the age of only 29, my capac-

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ity is that of assistant chief draftsman, in charge of engine design.

All thanks to those correspondence courses! They were tough, and took a lot of time, but they made me what I am today. I still believe that hard work and study is the only road to success.

—J. J. T., Detroit, Mich.

"GETTING SOMEWHERE AT LAST"

Twenty five years ago I graduated from high school. My father was a fairly well-to-do farmer, and because I wanted to attend one of the large mid-western universities he consented to send me. Rather hazy on what particular course to study, I enrolled as a special student in law school, not because I wanted to become a lawyer, but because I had an idea that a knowledge of law might help me in after life.

Here I was, a very raw undergraduate with a record as a rather dull student in high school as a background, in a strictly graduate school (undergraduates could only be admitted as special students) and of course I failed gloriously—lasting out only the first year.

After leaving school, I had various jobs, ranging from ordinary factory work to the district managership of an industrial health and accident insurance company. Adjusting insurance claims had always attracted me, and in 1928 when I found myself working in a gas and oil service station I began the study of law all over again (this time by correspondence) with the expectation of getting in the insurance field again as a claim adjuster, a position which, of course, required certain legal knowledge.

However, in 1930 I had a chance to connect with the collection agency that I am now with, and while the depression caused me to have to discontinue my course before I had entirely finished it, the school kindly let me keep the full set of books sent me, and, further than that, sent me the remainder of the lessons which I eventually worked out.

Due to knowledge that I have gained in going over my lessons, I have been able to handle any legal problem that has arisen in connection with my work, and all procedure in the lower courts where laymen are permitted to practice under State Statute.

After twenty years of rather careless drifting, I think I have found myself, thanks to my home study course. While perhaps I am not making as much money as some, I know that I am getting somewhere at last, for recently one of our clients offered me a place in his organization to take charge of collections, and in this year of 1937, when an employer hunts up a prospective employee and offers him a position, it must be because the employee has a reputation of doing his work well.

—R. H. M., Battle Creek, Mich.

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ODD GOLD-MINING PLANT TAKES METAL FROM SOIL

GOLD-MINING plants, which extract the precious metal from the soil in which they grow and concentrate it in their seeds and stems, have recently been discovered by a Czechoslovakian scientist. Called "scouring rushes," the plants were grown in earth which contained less than three thousandths of an ounce of gold to the ton. When they were later burned, their ashes proved to contain more than twenty ounces to the ton—sufficient to make them commercially valuable if there were only enough of them available. It is not expected that the vegetable miners can be used to extract gold out of low-grade ores or soils, but the study of their peculiar ability may reveal interesting facts.

TASTE TEST DETERMINES FAVORITE FLAVORS

WHAT FLAVOR do most people like best? To settle this question for the benefit of druggists who disguise unpleasant-tasting medicines with flavoring extracts, Harold N. Wright, a pharmacologist, recently conducted a taste test among students at the University of Minnesota. The flavor honors were carried off by chocolate and raspberry, with orange, cherry, sarsaparilla, and citric acid as close rivals. Bitter drugs are best concealed by chocolate and raspberry extracts, it was found, but salty drugs are best disguised with either cinnamon, orange, or sarsaparilla.

JUICE OF ONIONS MAKES HUMANS CRY, GERMS DIE

CONSTITUENTS of onions and garlic that bring tears to the eyes of human beings have germ-killing powers that may be useful in fighting disease, according to a theory advanced by two California scientists. The fact that onions are almost immune to bacterial attack led to a search for the secret of their germ-resisting powers, and to the isolation of the germicidal substances. Tests are now under way to determine the usefulness of these chemicals in healing infectious diseases.

TWO-IN-ONE FIELD GUN ADOPTED BY BRITISH

COMBINING the best fighting qualities of two types of field gun used in the World War, a new weapon adopted by the British Army is expected to effect a great increase in the efficiency of artillery units. It will replace the heavy, plunging-fire howitzer formerly used against troops in trenches, and the lighter, shrapnel-firing eighteen-pounder employed for shelling an enemy in open country. Being able to perform both these functions, the new gun will simplify the organization of artillery brigades and eliminate the necessity of having two kinds of battery in action at the same time. Although details of the new weapon are still secret, it is understood to have a caliber somewhere between the 3.3 inches of the old eighteen-pounder and the 4.5 inches of the field howitzer. Two types of shell—shrapnel and high-explosive—will be used interchangeably.

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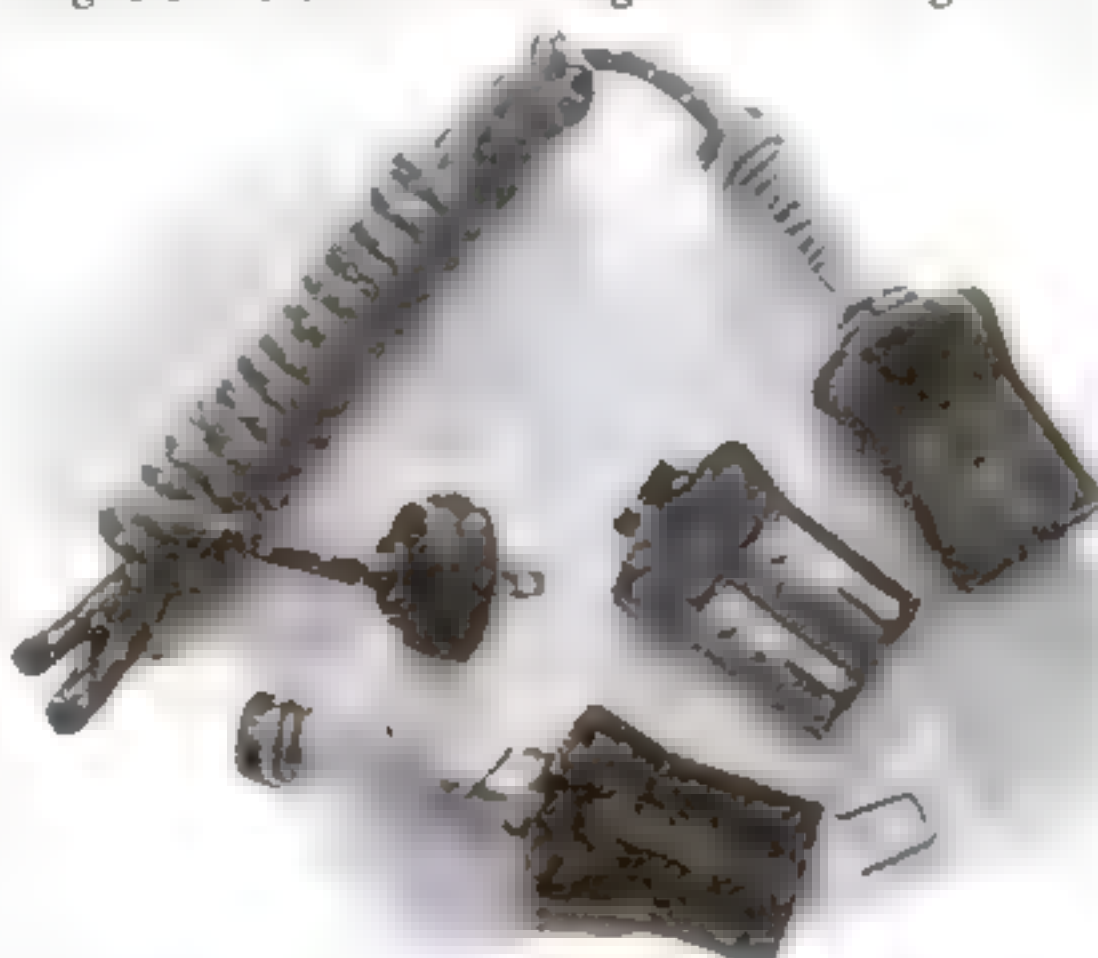


This lock has a funnel-like face that guides the key to the slot

TO MAKE keyhole-finding easier, a California inventor has devised the novel funnel-shaped lock shown at the left. A key aimed at the lock is automatically guided into the keyhole by a flat, conical depression on the outer face of the fitting. The new keyhole is particularly suited for front doors and garage doors where the light is poor or entirely lacking. The same design also can be applied to smaller locks such as those used on car doors and spare tires.

WIRE CLIPS REPLACE SCREW IN ELECTRIC PLUG

INTENDED for use with household appliances, a new electric plug is held together with easily placed spring-wire fasteners instead of the usual screw. A wire ring snaps over the neck at the top of the plug, and a U-shaped clip fits into a slot at the bottom. The clip can be removed with any pointed tool, after which a slight twist causes the ring to leave its groove.



The plug is held together by a wire ring and a clip

METAL SNAPS HOLD SCREENS IN PLACE

DESIGNED to ease the task of installing window screens and storm sash, rustproof fasteners recently placed on the market allow the frames to be snapped into place easily and quickly. Consisting of a spring-steel, lever-action finger that grips the screen or sash as shown in the photograph, the new fastener is easily screwed to the edge of the window frame.

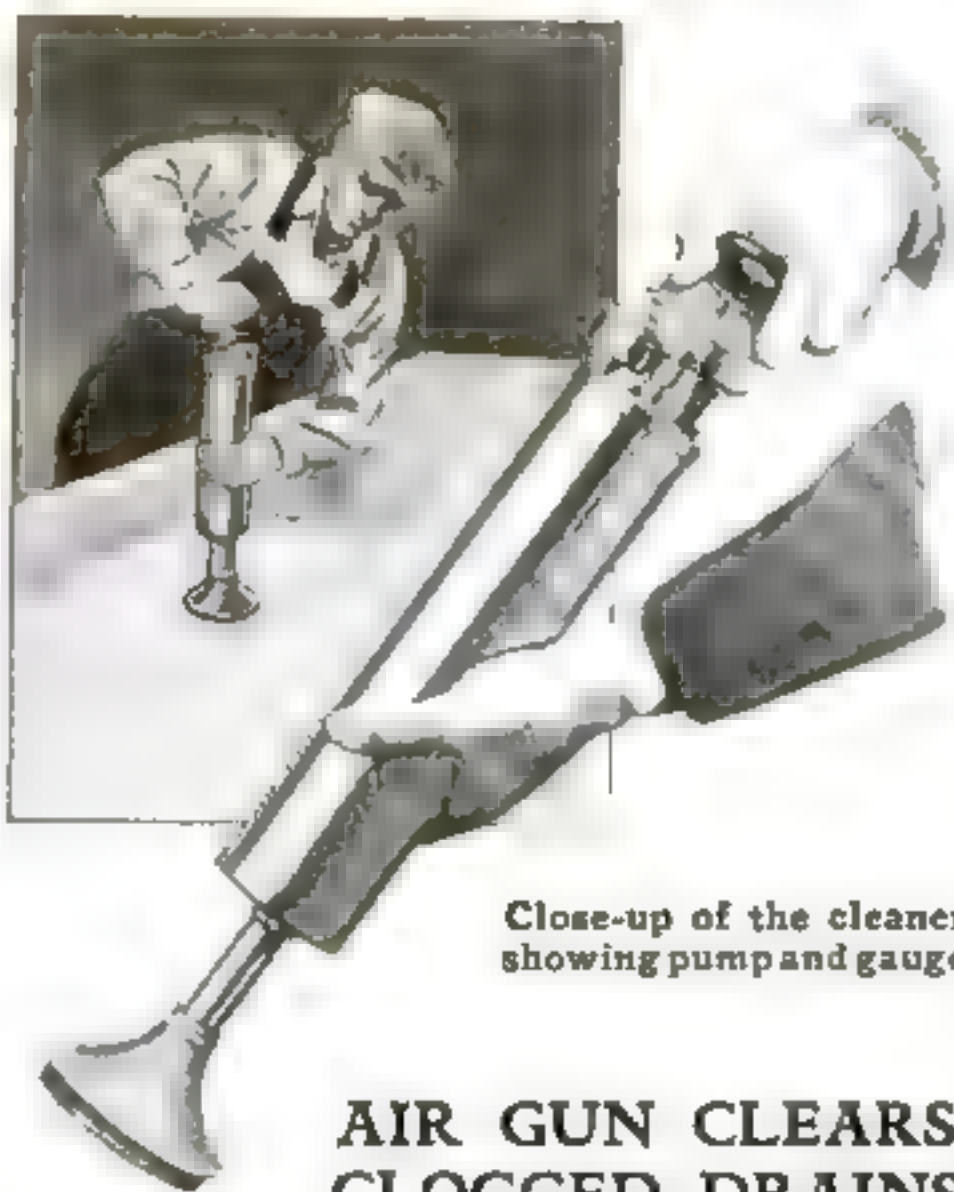


NEW WALL PLUGS MADE OF RUBBER

FLEXIBLE and nonsplitting, rubber wall plugs now available simplify the problem of placing screws in plaster or tile. Sold in six-inch lengths and in various diameters, the hollow, tube-like material is simply pushed into the hole and cut to length with a knife. Made of rubber, the plugs not only absorb shocks and vibration, but are practically indestructible. Each size of plug, according to the manufacturer, will take several sizes of screws.



How rubber plug material is inserted in holes in plaster walls

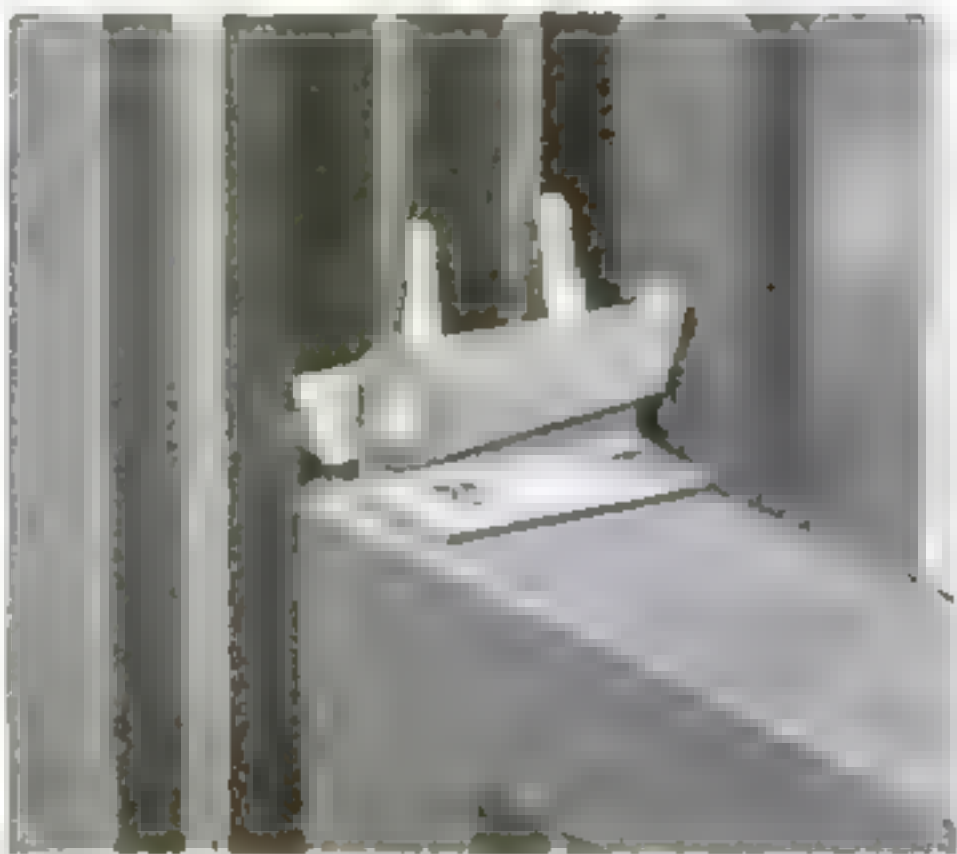


Close-up of the cleaner showing pump and gauge

AIR GUN CLEARS CLOGGED DRAINS

WITH a special "air cannon" now available, badly clogged drains can be cleared easily and quickly. Shooting a charge of compressed air into the pipe, the mechanical cleaner provides a clearing force up to eighty pounds; sufficient pressure to loosen almost any obstruction. In use, the clogged pipe first is filled with water up to the mouth of the drain. A rubber cup at the end of the cleaner then is placed over the drain and a built-in hand pump operated until the pressure gauge shows a pressure of at least thirty-five pounds. When the trigger is pulled, the charge is released into the pipe and the column of water ahead of the air acts as a battering ram to force the drain open, even though the obstruction is many feet away from the drain opening.

SPRING CATCH FASTENS WINDOW AT ANY HEIGHT



WINDOWS left open all night for ventilation provide an easy entrance for burglars and sneak thieves, particularly if they are on the ground floor. With a new spring-grip catch, however, windows can be locked in any position and in such a way that neither sash can be moved. Easily mounted on the top of the lower frame with two screws as shown in the picture above, the lock is equipped with two finger levers which need only be pushed together to allow the window to be raised to the height desired. When the windows are to be cleaned, the levers may be set to permit easy opening and closing.

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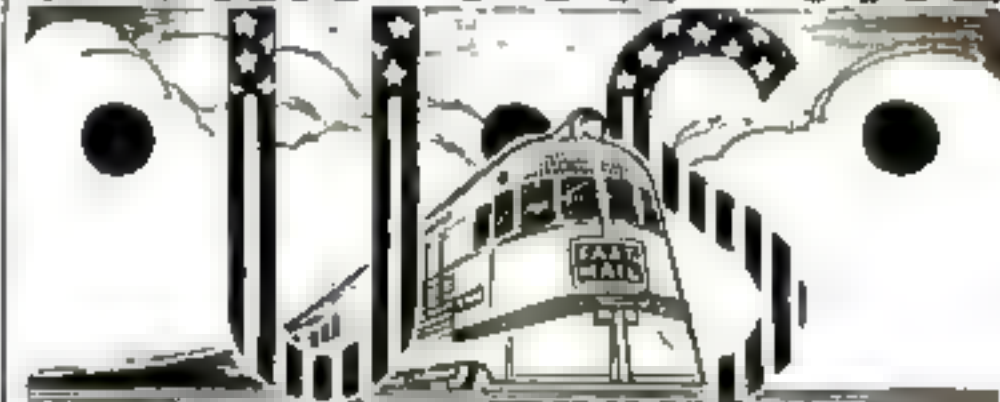
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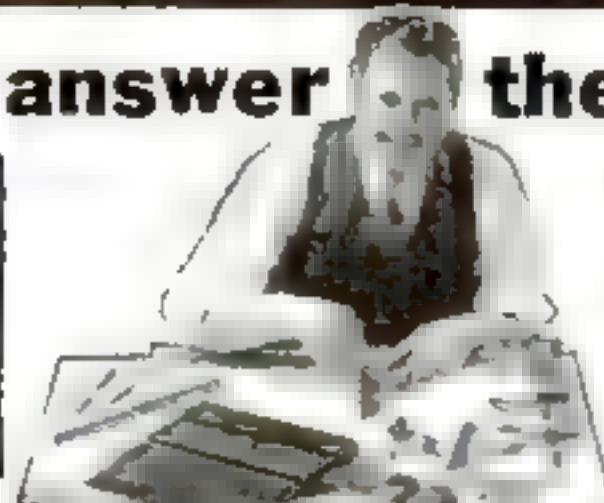
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Questions

FROM HOME OWNERS

Q.—How can we remove some tarnish spots from the copper fixtures in our bathroom? D.L., Augusta, Me.

A.—Rub the tarnish stains with a saturated solution of common salt in vinegar, and then rinse off with clean water.

Linoleum Hides Bad Flooring

L.C.B., COLUMBIA, S. C. Old softwood floors are often in such a condition that it is hard to make them look well by any method. In this case, it might be advisable to cover the floor with linoleum around the exposed portions not covered by a rug. A number of manufacturers produce linoleum in designs that closely simulate both hardwood and softwood graining.

Brightening Dull Shellac

O.R.F., KINGSTON, N.Y. Shellacked floors often take on a grayish, cloudy appearance because of excess moisture in the air. The condition can be remedied by lightly rubbing the floor surface with a soft cloth that has been dampened with denatured alcohol.

Calcimine Over Old Plaster

Q.—To DRESS UP the walls of my kitchen, I have been considering putting on some calcimine. However, the plaster is old and the ceiling is in particularly bad shape. What should I do to prepare the plaster for calcimining?—H.M.S., Little Rock, Ark.

A.—THERE is no reason why you cannot get a perfectly good job of calcimining on your walls and ceiling, in spite of the condition of the plaster. First clean the surface thoroughly with a strong solution of washing soda. When it is thoroughly dry, apply a coat of varnish size, and over this the calcimine.

Cleaning Brickwork

R.K.Z., St. Louis, Mo. Smudged and sooty brickwork around a fireplace can be cleaned with mechanic's hand soap. Use a stiff brush or some wire wool, and rinse off with clear water.

Rumbles in Toilet Tank

J.M.B., MOBILE, ALA. A rumbling noise that occurs in a toilet flush tank as it fills with water is due to an improperly seating inlet valve. Sometimes it can be cured by bending the float rod slightly, but it is better to dismantle the valve and put in a new washer.

Leaky Garden Hose

L.M.D., ROCHESTER, N.Y. A leak in the garden hose can best be repaired by cutting out the defective section and joining the ends of the hose with a coupling, obtainable in any hardware store.

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FOR the convenience of readers who wish to build the ship models described in this magazine from time to time, we have prepared construction kits that contain all the necessary raw materials. Complete instructions and full-size blueprints are included so that work can be started as soon as the kit is purchased.

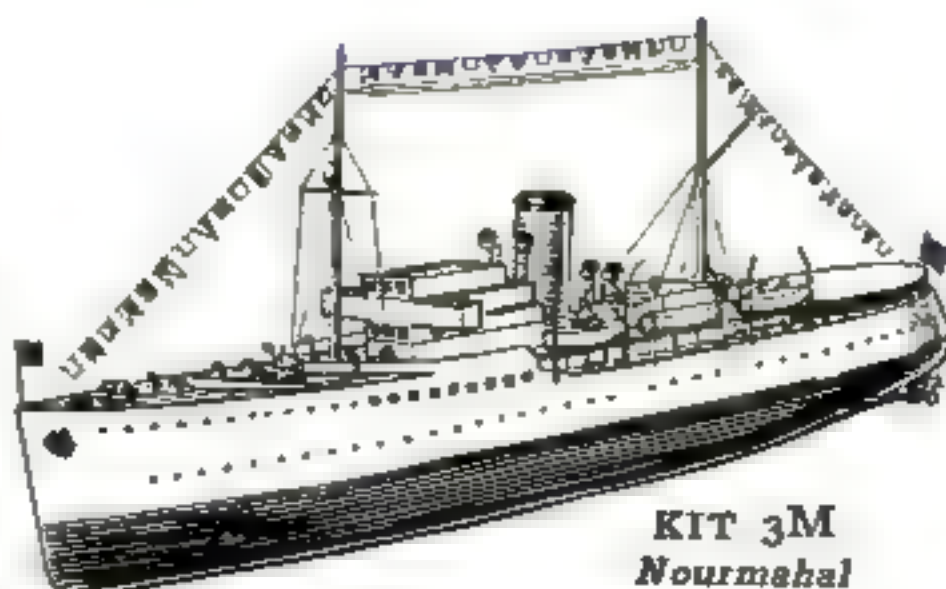
The increasing popularity of our kits indicates that more and more model makers are realizing how much time and money may be saved by taking advantage of this service. An experienced model maker has selected the materials, cut out the hull parts and strips, and put everything in a convenient package, just as you would have to do yourself if you bought your own raw materials.

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- D. Spanish galleon, 24-in. hull, 30 in. over all 6.95*
- E. Battleship U.S.S. *Texas*, 3-ft. 7.45*
- G. Elizabethan galleon *Revenge*, 25-in. hull, 28 in. over all 7.25*

(Continued on page 18)



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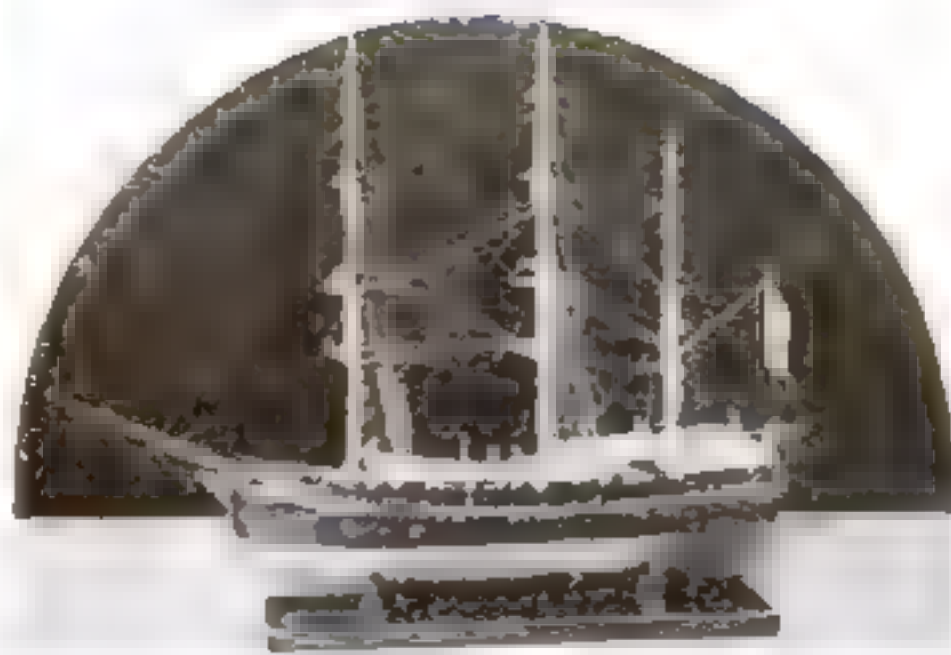
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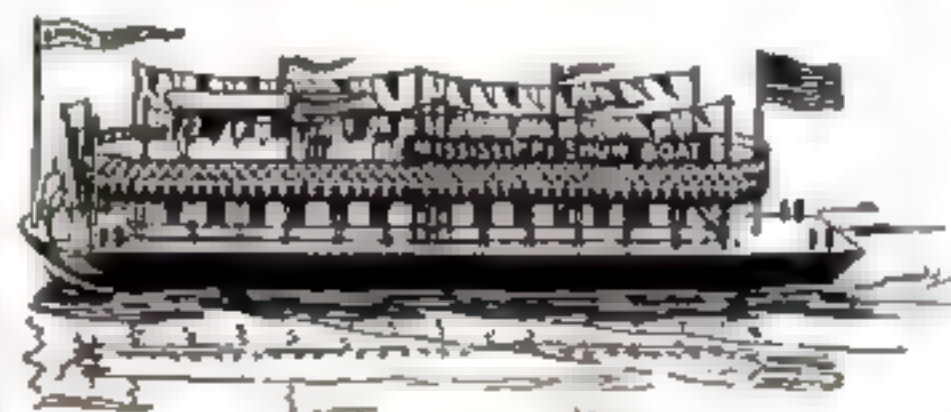
OUR CONSTRUCTION KITS

(Continued from page 17)



KIT A—Model of whaling ship *Wanderer*

- L. Farragut's flagship *Hartford*, steam-and-sail sloop-of-war, 33½-in. hull, 41 in. over all 8.45*
- Q. Privateer *Swallow*, 12½-in. hull, 20 in. over all 4.95†
- V. Clipper *Sovereign of the Seas*, 20½-in. hull, 26 in. over all 4.95†
- Y. Trading schooner, 17½-in. hull 4.90†
- 2S. U. S. Navy Destroyer *Preston*, 31½-in. hull 5.95*
- 3S. *Constitution* ("Old Ironsides"), 21-in. hull, 31 in. over all 6.50*
- 4S. Clipper ship *Great Republic*, 31½-in. hull, 42 in. over all 8.40*
- 5S. Coast Guard patrol boat of new 165-ft. class. Full-hull model, 1½-in. scale, the hull being 20¾ in. long 4.95*
- 6S. Brig *Malek Adhel*, ¼-in. scale, 20-in. hull, 33 in. over all, frame-and-plank construction; finely finished boxwood blocks, deadeyes, belaying pines, grating, etc., are included 9.75†
- 7S. Brig *Malek Adhel*, as above, but with saved-out lifts for solid hull construction 9.75*



KIT 1M—An illuminated show-boat model

SIMPLIFIED SHIP MODEL KITS

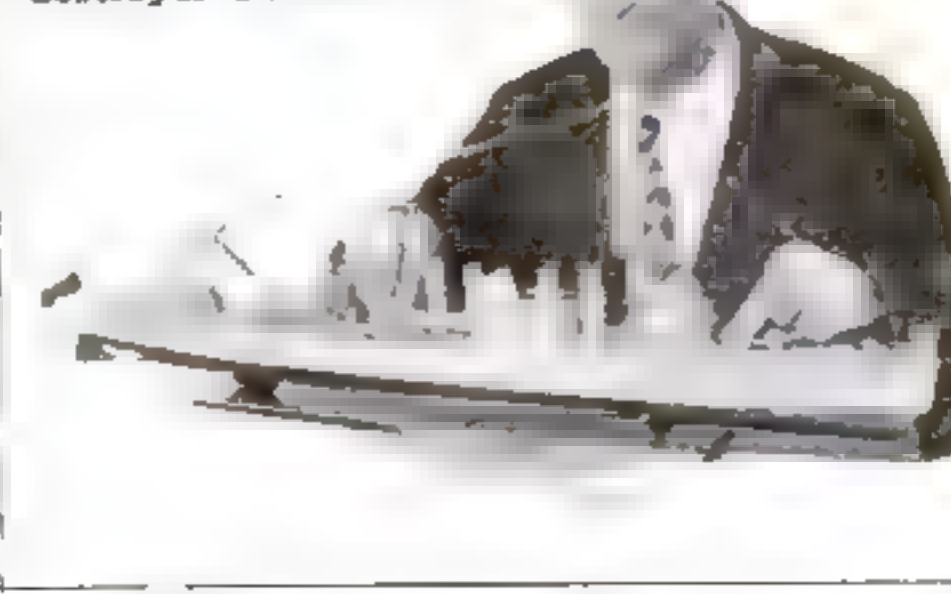
- F. Liner S.S. *Manhattan*, 12 in. 1.00
- H. Cruiser U.S.S. *Indianapolis*, 12-in. 1.50
- J. Clipper ship *Sea Witch*, 13-in. 1.50

MODEL-OF-THE-MONTH KITS

- M. Aircraft carrier *Saratoga*, 18-in. \$1.00
- N. Four U.S. destroyers, each 6¼-in.75
- O. Liner S.S. *St. Louis*, 11-in. 1.00
- R. U. S. cruiser *Tuscaloosa*, 11¼-in. 1.00
- U. *Hispaniola*, the ship in "Treasure Island," 7-in.50
- Z. H.M.S. *Bounty*, 11½-in. 1.50
- 1M. Show boat, illuminated, 14-in. 1.50
- 2M. Ocean freighter, 14-in. 1.50
- 3M. Yacht *Nourmahal*, 8½-in. 1.00
- 4M. Oil tanker, 14-in. 1.50

(Continued on page 19)

KIT 2S—U. S. S. destroyer *Preston*



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OUR CONSTRUCTION KITS

(Continued from page 18)



Included in Kit 10 is a master model of the tramp to be carved from the whittling block

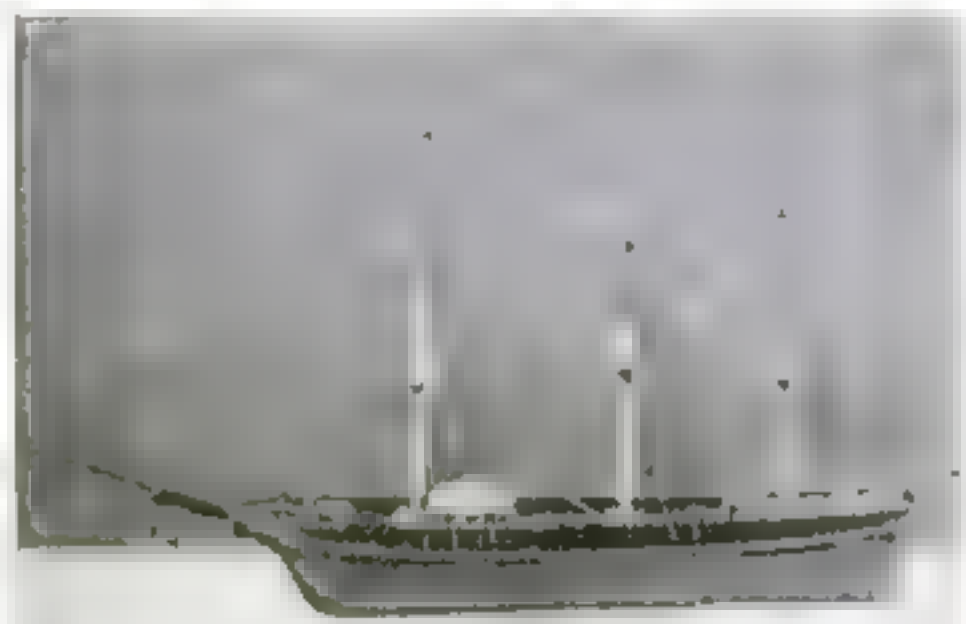
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KIT J—Materials for a miniature clipper ship

No. 8. Whittling kit for six different Scotties. Each is 2 by 2¼ in., sawed to shape. Paint, paintbrush, sharpening stone, beads for eyes, and instructions are included..... 1.00

No. 9. Whittling kit with shaped block for making a sailor 5¼ in. high. Paint, brush, and sharpening stone are included..... .75

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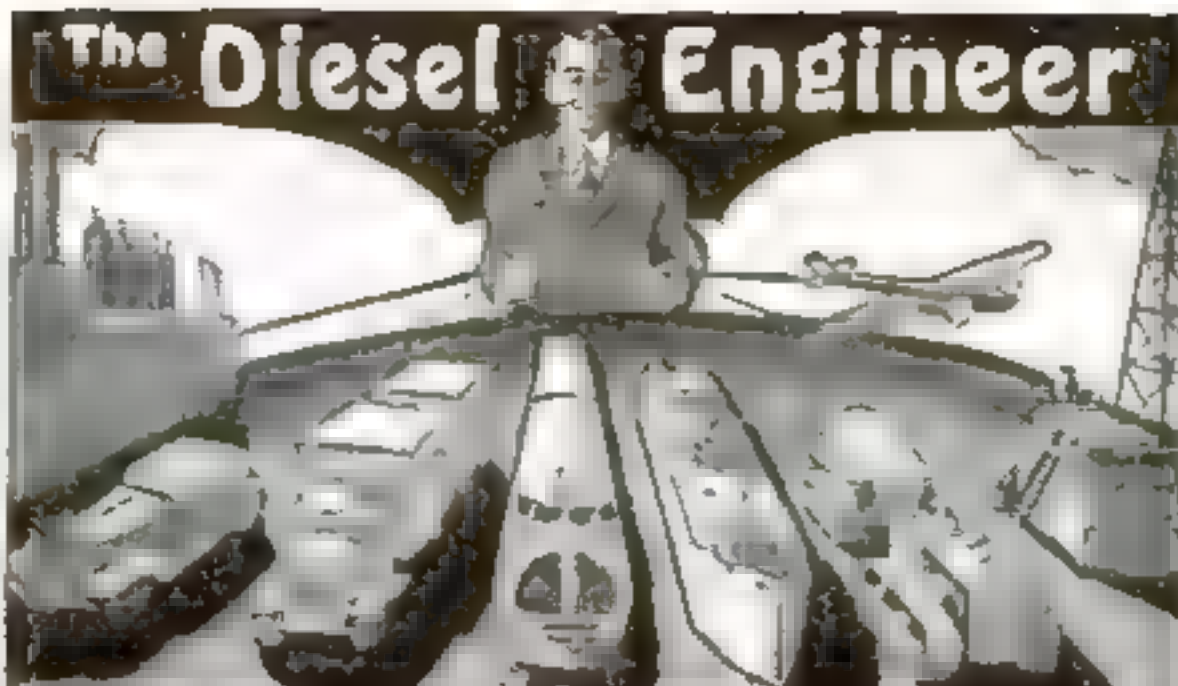
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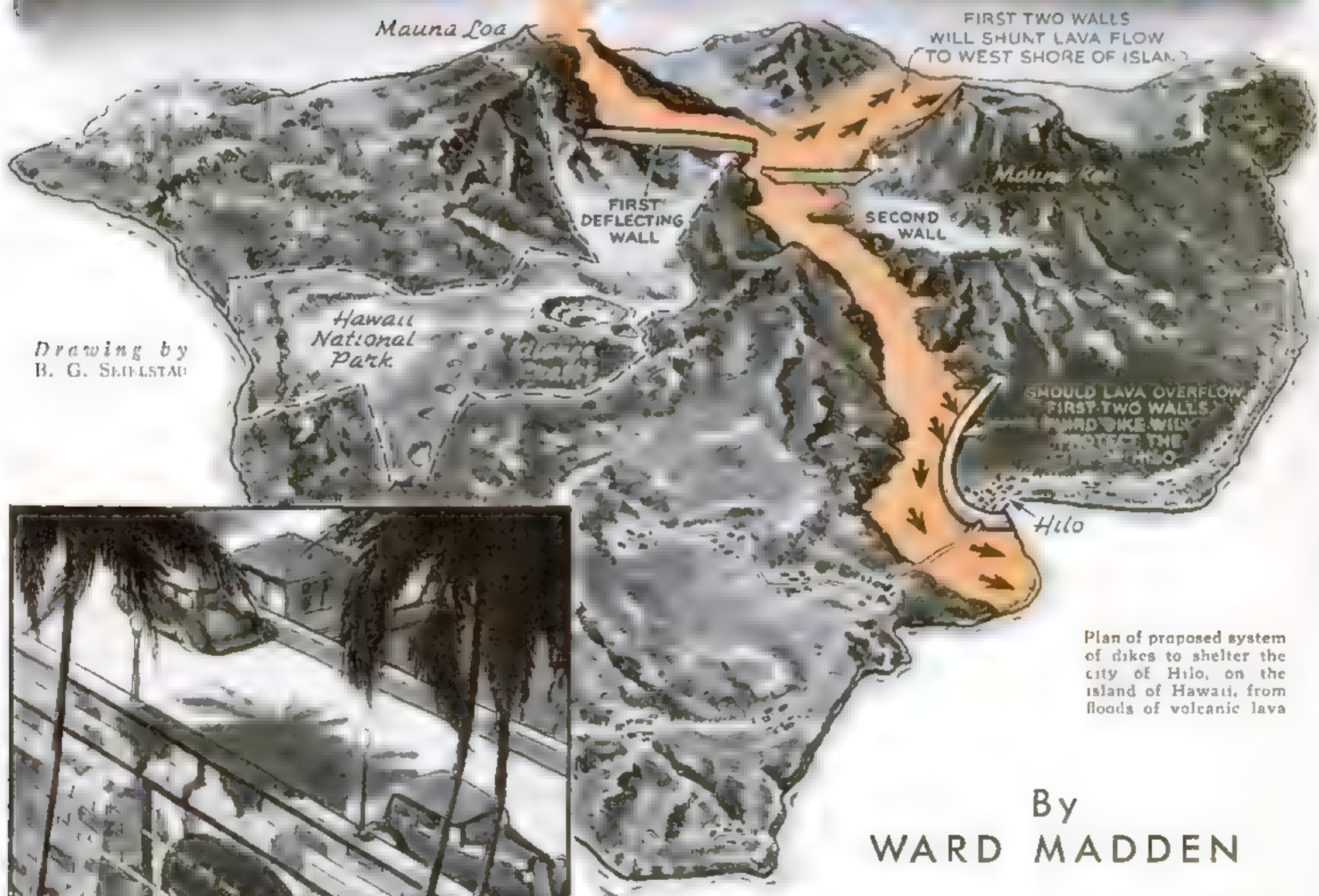
JULY 1937

POPULAR SCIENCE

VOL. 131 NO. 1

Monthly
RAYMOND J. BROWN

DAMMING A RIVER OF FIRE



Drawing by
B. G. SKILLSTAD




Walls would have highways on top and gates for cross arteries, with steel barriers to close the openings against an eruption

By
WARD MADDEN

THE strangest fortification line on earth is being planned for the island of Hawaii. For thirteen miles across the flanks of Mauna Loa, the world's most active volcano, high barricades will dam and divert rivers of fire. This daring scheme is designed to protect the Hawaiian city of Hilo, with its 20,000 inhabitants, from the volcano's flow of lava. Science, for the first time in history, has declared war on a volcano.

Dr. Thomas A. Jaggar, director of the Hawaiian Volcano Observatory, is the originator of the plan. For twenty years, Dr. Jaggar literally has lived with Hawaii's famous volcano. He has studied it, tested it, kept a day-to-day record of its changing pressures, its shifting temperatures, its altering aspects. His home, hung inside the walls of the vast Kilauea crater, the largest opening on the sides of Mauna Loa, is unique among habitations. It was there, not long ago, that Dr. Jaggar explained to me his plan for a scientific battle line to



During the 1935 eruption, U.S. Army flyers bombed lava streams to divert them and break them up to cool off and harden

safeguard the city of Hilo.

Mauna Loa, he pointed out, is the second highest peak in the Pacific. It towers 13,675 feet above sea level. Once every three and a half years, on the average, incandescent rivers of lava flow down its sides. At three strategic points—one at 10,000 feet, another at 7,000 feet, and the third at 2,500 feet—Dr. Jaggar plans to erect his barricades of concrete and igneous rock to turn the tide of lava down relatively uninhabited valleys to the sea.

The uppermost rampart will be fifteen feet high and five miles long. It is expected to cost in the neighborhood of \$300,000. This embankment will give the lava its first impetus to the west. The second barricade, as tall as a two-story house and one mile long, will plug up the saddle between Mauna Loa and its neighboring peak, Mauna Kea. It will cost about \$100,000. Already, CCC workers have completed ten miles of road which makes accessible the site of the highest embankment.

The final barrier is to be seven miles long and eighteen feet high, curving to the west of Hilo like a gigantic parenthesis mark. If the lava

breaks past the first two embankments, this final wall is expected to turn the flow away from Hilo into the Pacific. Starting at an elevation of about 2,500 feet, the \$400,000 barricade will curve downward almost to sea level. Rivers, railways, and highways will pierce the wall through arched openings. But immense steel gates will be provided at each arch, huge doors that can be rolled shut in times of emergency.

Although the total cost of the project is thus approximately \$800,000, the amount is small in comparison with the value of the property it is expected to protect. The physical valuation of Hilo, alone, is \$50,000,000.

Three valleys, scarring the eastern slopes of Mauna Loa, converge just above Hilo. Like troughs, they tend to lead the lava toward the city. Although the community is forty miles from the summit of the volcano, lava flows on several occasions have pushed close to its outskirts.

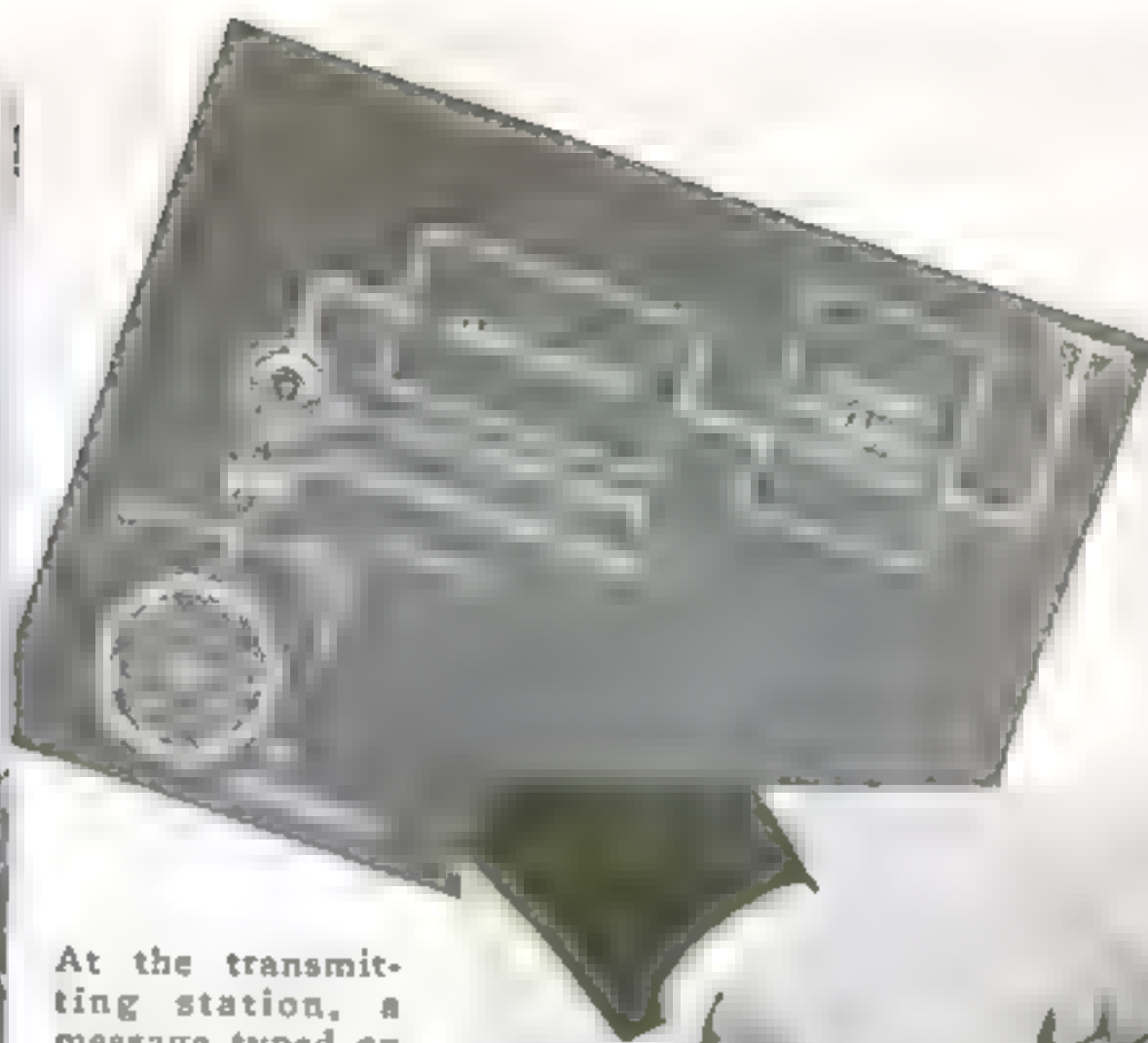
In 1885, during an eruption which lasted for sixteen months, the lava approached within five miles of the city limits. In 1881, the molten river, fed for nine months by the lava springs of Mauna Loa, crept to within one mile of the Federal Building in Hilo. At times, these streams of melted rock have a temperature of 2,000 degrees Fahrenheit. Even a year after an eruption has ceased, it is possible to cook steaks on the blackened lava far down the mountainside.

Two years ago, in 1935, one of the most spectacular of Mauna Loa's many eruptions came to a dramatic climax.

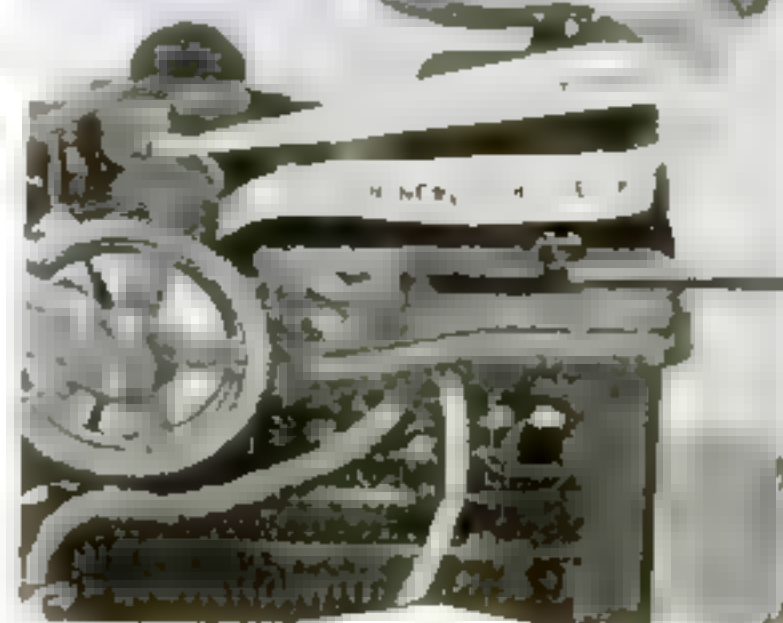
About seven o'clock in the evening on November 21, a sharp earthquake shook the island. Six hours later, a tidal wave struck the waterfront, hurling spray twenty-five feet in the air. At dawn, red lava was pouring down the side of Mauna Loa, eating its way through a dense forest. Trees, swirling in the molten eddies, generated steam in their moist cells and exploded as though filled with gunpowder. At some places, the smoking rivers of lava were rushing downward at fifteen miles an hour; at others, they were cascading over cliffs like flaming Niagaras. Clouds of smoke and gas rose into the sky and the red glow of the incandescent rock was visible 175 miles away on Oahu Island.

Day after day, the flow continued. It passed the saddle between Mauna Loa and Mauna Kea, and headed down the eastern slope toward Hilo. Dr. Jaggar circled overhead in a swift army plane watching developments. The main stream was a mile wide with more than fifty rivu-
(Continued on page 102)

The enemy at the gates: molten lava creeping up to the outskirts of Hilo in 1935. Below is a remarkable night photograph of the river of fire flowing from the crater



At the transmitting station, a message typed on translucent tape is fed into the television cabinet, scanned by an electric eye, and broadcast by radio



Television Newspaper

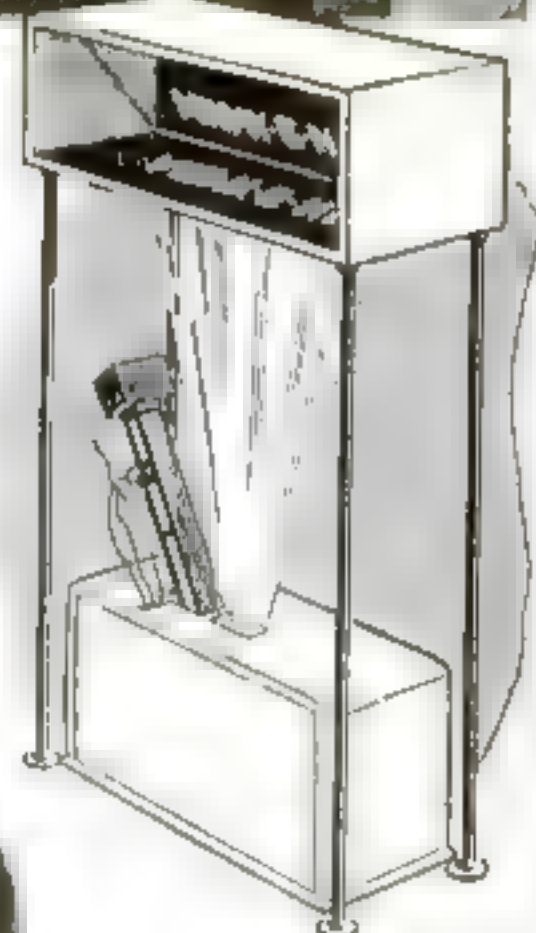
BROADCASTS WORDS TYPED ON TAPE

FLASHING news reports, stock-market quotations, farm prices, and other types of information in printed form, an apparatus recently designed by William H. Peck, New York inventor and former U. S. Navy optical expert, has introduced a novel form of television news service.

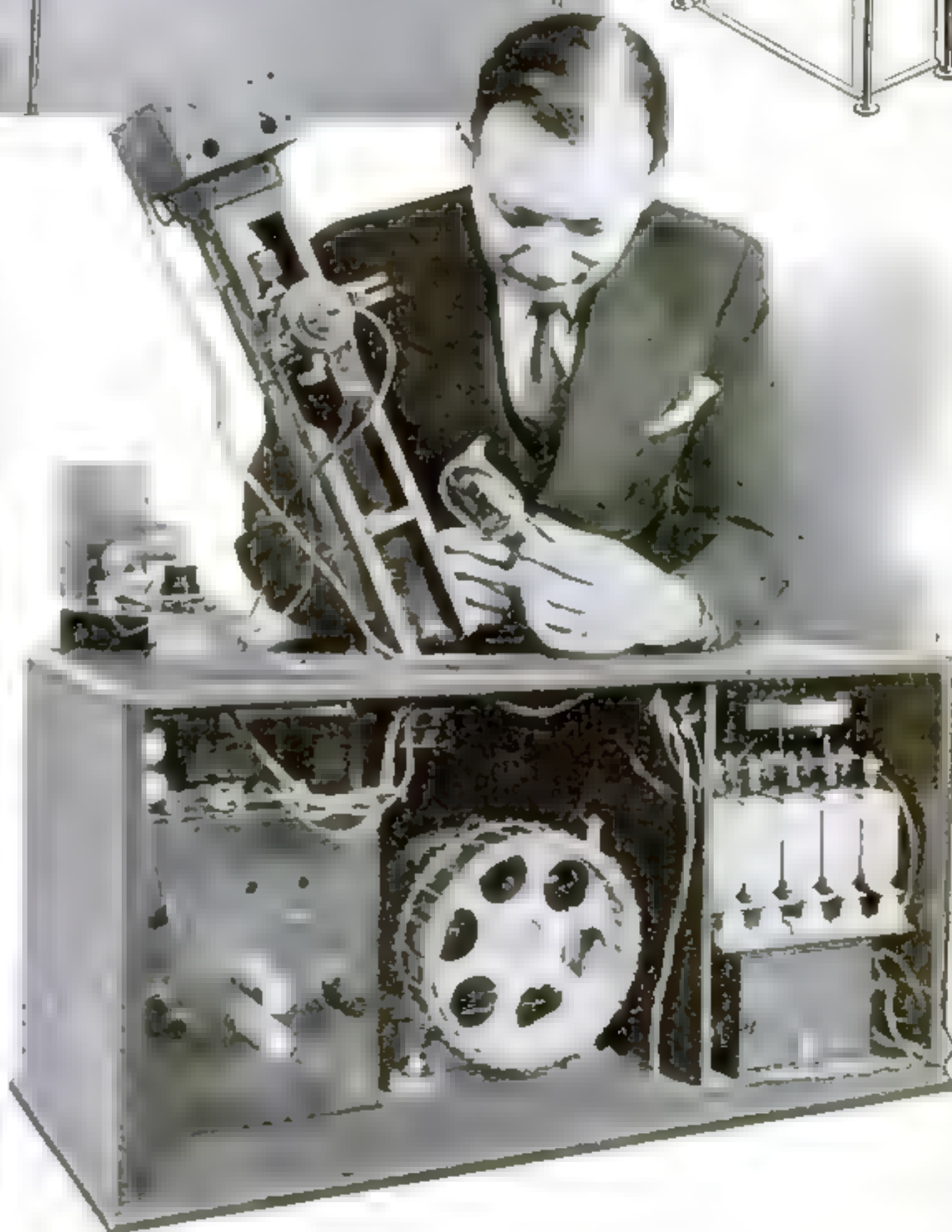
At the broadcasting station, an operator types out the items on a continuous translucent cellulose tape which is fed automatically into a cabinet holding the television sending apparatus. Here, a light beam, reflected from the tiny mirrors of a rotating scanning drum, passes through the cellulose strip before reaching a photo-electric cell which transforms the variations in light intensity into electrical impulses. These, in turn, are amplified and sent out by short-wave radio.

Picked up by the antenna at a receiving point, the impulses are carried to an ingenious light valve which varies the amount of illumination passing from a lamp to another mirror-studded scanning drum according to the strength of the impulse. The drum, whirled by a small electric motor, throws the light upward onto a frosted glass panel in a shadowless viewing cabinet. The words and figures originally typed on the cellulose tape at the broadcasting station appear here and are reflected, for ease in viewing, by a tilted mirror within the top of the cabinet. These images are reported to be so clear that they can be read easily in daylight. The items broadcast move across the viewing screen in the manner of a trailing electric sign.

It is possible to operate the new service over telephone lines as well as by radio, wires instead of ether waves carrying the impulses. Initial cost and operating expense are said to be small.



The receiving apparatus, shown at right, retranslates the impulses into light and projects the words or numbers onto a screen, across which they move after the manner of a trailing electric sign



THESE SIMPLE HINTS WILL HELP YOU LEARN

SURFBOARD RIDING



Surfboard riders using their arms for balancing as they rocket along on the forward slope of a racing wave

WHERE the sea throws itself shoreward in smooth, powerful swells, you will find the wave riders—bronzed, muscular swimmers who have studied well the whims of Father Neptune and know how to hitch their buoyant surfboards to the bounding water. Their shouts ring out above the thunder of breakers as they stand upright on the polished planes of wood and rocket along on the forward slope of a swiftly advancing wave.

Merely to witness a masterful performance of wave riding imparts some of the delicious thrill known to these aquatic artists. And if you are at all addicted to water sports, you will feel a commanding urge to duplicate their feats. Before you do, however, it will be well to learn from the beginning some of the fine points in the ancient art of hitching a ride on the waves.

Most surfboards range from ten to twenty-one feet in length, by eighteen to twenty-four inches in width, and weigh anywhere between thirty and 165 pounds, depending upon the

material and type of construction. For wave riding, preference is given the shorter board, generally under thirteen or fourteen feet, since it is more easily handled. Boards of greater length are usually to be associated only with veteran riders, who are likely to own a number of surfboards of varied design. The longest boards, twenty or more feet in length and only eighteen inches in width, are used more for paddling races than for actual surf riding.

Choose your board according to your size and weight. A youngster may find an eight-foot board quite adequate, while a tall, 200-pound man may have his best success with an air-chambered board not shorter than twelve feet. The average person will not be making a mistake if he practices with a surfboard somewhere between ten and twelve feet long, approximately twenty-two inches wide, and weighing not more than fifty pounds. In this classification you have a choice between the traditional ten-foot board, usually built of light balsa wood, and the



Cigar-shaped boards of the air-chambered type. The longer board is used principally for paddling races



Most paddlers stroke simultaneously with both arms as shown below. In the photograph at the left, note the sidewise standing position which permits the weight to be shifted easily to the front or back of the surfboard



By PAUL W. GARTNER

more modern cigar-shaped board, which contains an air chamber throughout its entire length.

Once you have selected a good surfboard, it is advisable that you first become a competent paddler. Prone upon your stomach, balance your weight on the board so that the deck is almost level with the water. A choppy surface will require a slight uptilt to the bow. Now, arch your back and raise your shoulders with face forward, and start to stroke with extended arms, as though they were the oars of a boat. Most paddlers, especially beginners, prefer to stroke simultaneously with both arms, although an alternating, over-arm stroke, similar to that used in swimming the crawl, also can be employed. It is interesting diversion, too, to paddle Indian-style on the knees, or in a sitting position.

But whatever the method, the stroke is made with the wrist and arm tensed, and fingers cupped together. Relax as the arm is being carried forward. On the hollow racing boards, practiced paddlers can sprint at approximately twice the speed of champion swimmers. Distance also is possible on the paddle board. Beach guards of Santa Monica, Calif., recently paddled from the mainland to Santa Catalina Island, a distance of more than twenty-six miles, in less than six hours. The paddle board also suggests adventure on lakes and broad rivers. When resting, merely sit upright on the board, astraddle near the point of balance.

When paddling, you have two methods of guiding your thin craft. To negotiate a slight curve, it is necessary only to vary the power of your strokes, or to dip one hand shallowly as you increase the force of the other. But in order to turn sharply, it may be advisable to drag one foot as well.

Most buoyant boards will carry two persons on a favorable surface, and you and a companion may paddle tandem fashion, timing your strokes rhythmically like members of a rowing crew. The more

experienced person should ride behind and act as steersman.

The paddle board can be used to advantage in accomplishing a water rescue, particularly where a swimmer has become tired and is unable to return to shore without assistance. Should the subject be helpless, it is recommended that you sit astraddle the board when attempting to drag his weight into an advantageous position.

The beginner should exercise caution when taking a surfboard through the breakers. Always keep the bow headed squarely into the incoming waves, and time your

progress so that the curling water will not crash down upon you. You may buck through breakers that are largely spent, but watch out for those which still have a forceful rumble. Where waves are breaking is the real danger zone. When attempting to pass a breaker at this point, it generally is advisable to slip from your board and, holding it firmly by the stern, drive it deeply into the rolling water, ducking as the crest of the wave sweeps over you. Should you happen to lose hold of your craft, remain submerged until the breaker has passed, and even then come up with your arms above your head. Strong men have been knocked unconscious when struck by a runaway surfboard.

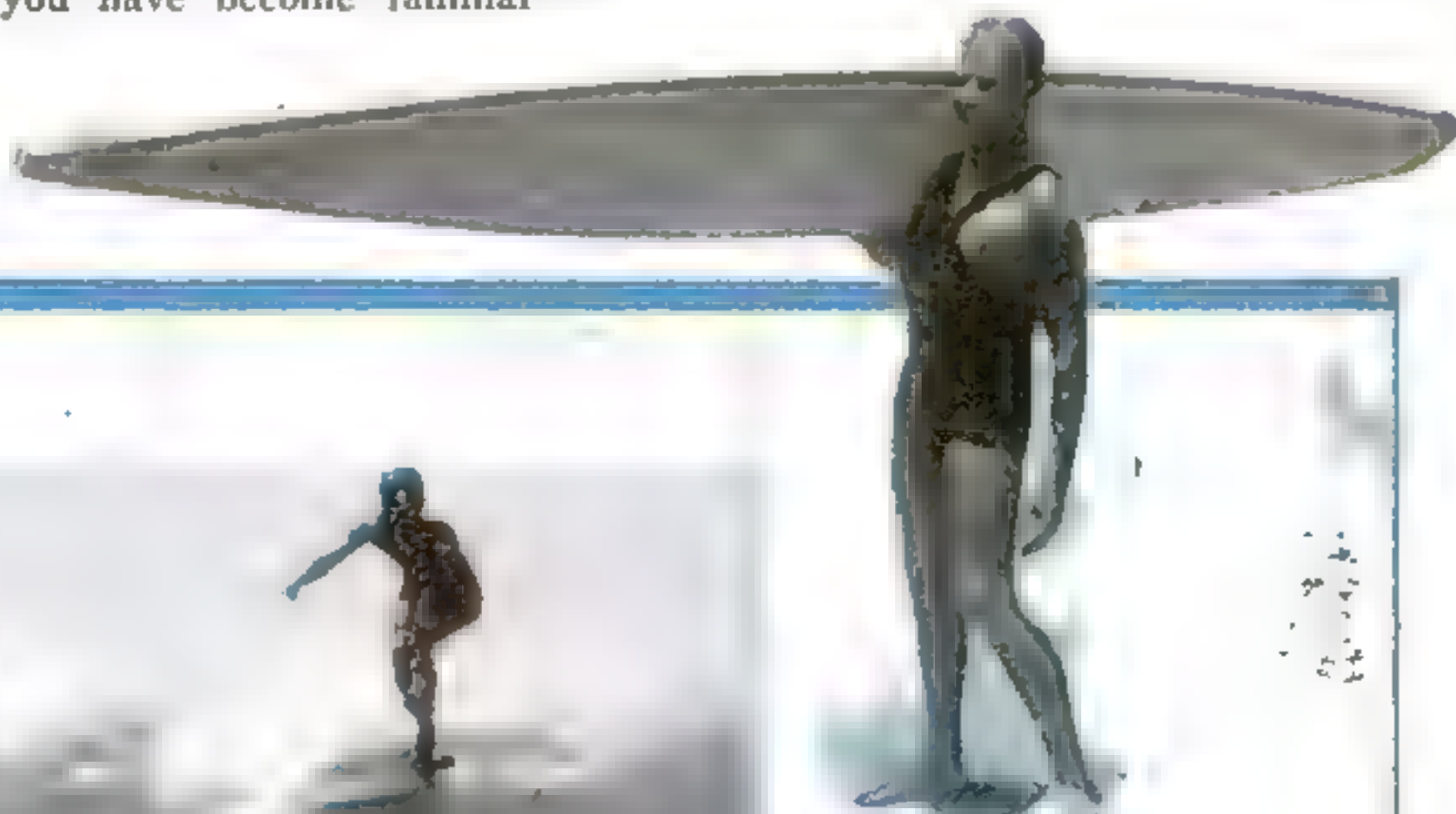
Now that you have become familiar



In tandem riding, the "passenger" rides in front of the steersman



To rest, sit astraddle of the buoyant board



The light, hollow surfboard is easily carried on the shoulder. At the left, four riders have caught a wave and are seen in the act of rising to their feet



RADIO LINKS SINGER AND ORCHESTRA



CONVALESCING from injuries received in an automobile accident, a radio performer recently sang to her audience from a room in a Philadelphia hospital, while she listened through headphones to an accompaniment played by a dance orchestra in a plane flying 5,000 feet overhead. A dual hook up enabled listeners on to hear the voice of the star perfectly blended with the music.



Orchestra in plane playing accompaniment for injured singer in hospital

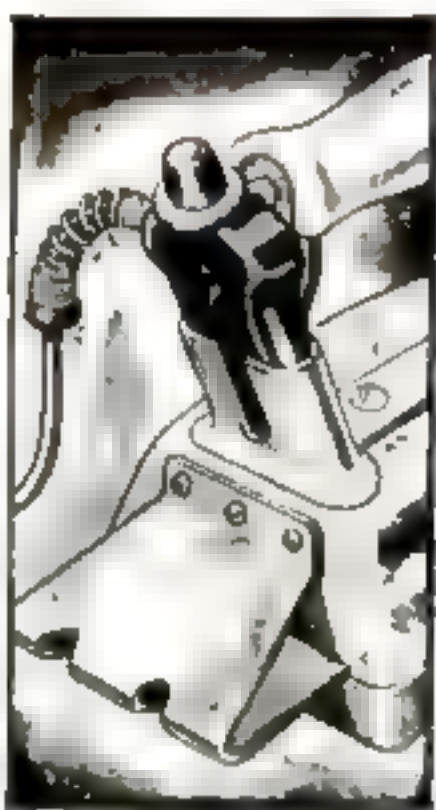


FIREMEN "SAVE" DUMMIES IN ODD RACE

AS A PART of their training in rescuing people from burning buildings, rival fire brigades of London, England, recently held a novel competition. Running up ladders to high windows, they lowered dummies in rope slings, the winners being the crew that landed the most "rescued" figures upon a marked square on the pavement within the allotted time. In the photograph above, a fireman is unfastening a dummy to be added to the pile.

PLUG GIVES CONTROL OF APPLIANCES

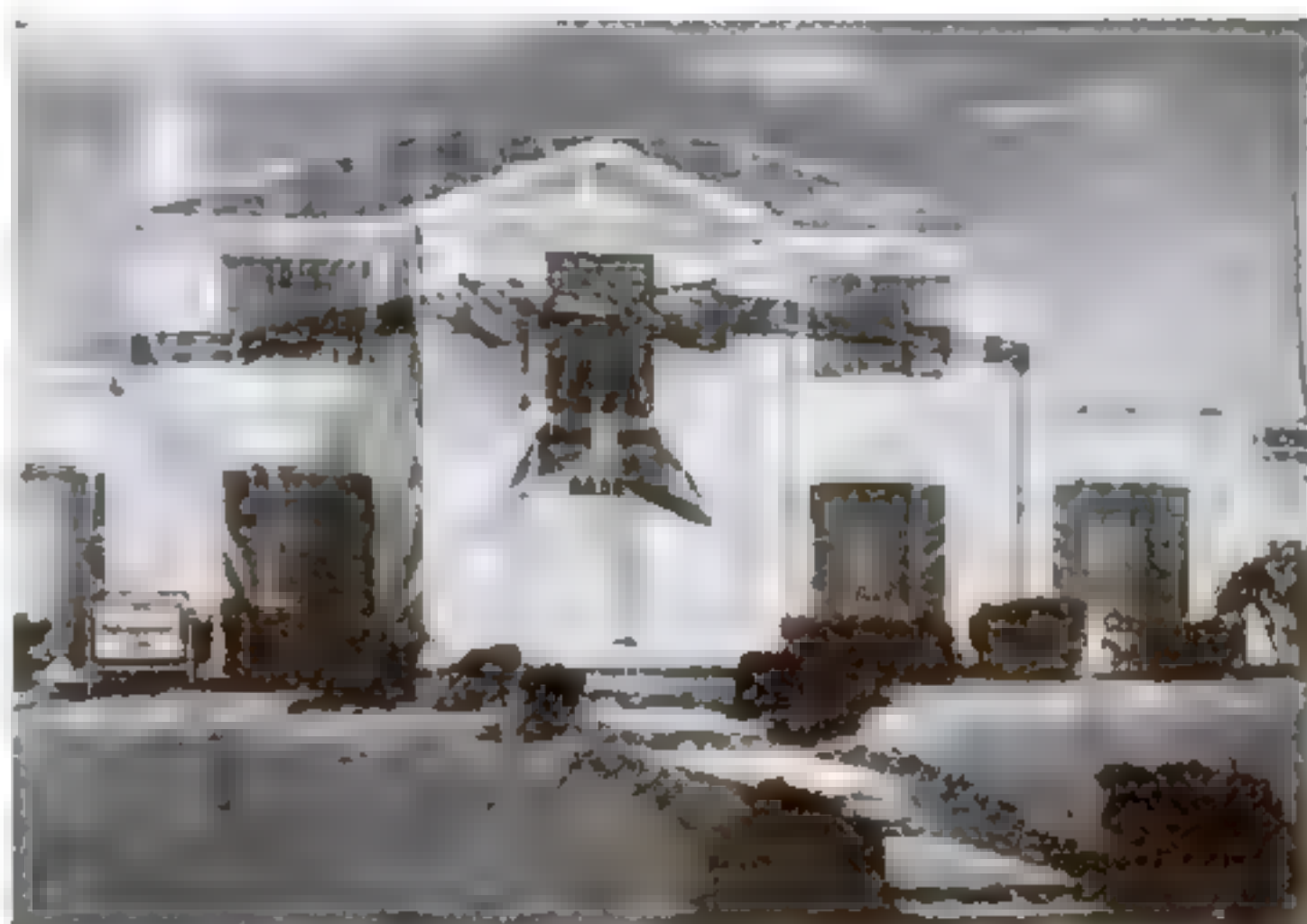
A NEW electric-appliance plug provides a handy knob to regulate the heat of any toaster, waffle iron, percolator, or electric cooker that lacks built-in thermostatic control. The temperature may be varied as much as twenty degrees, if desired, by a slight turn of the knob.



Electric-appliance plug with knob for temperature control

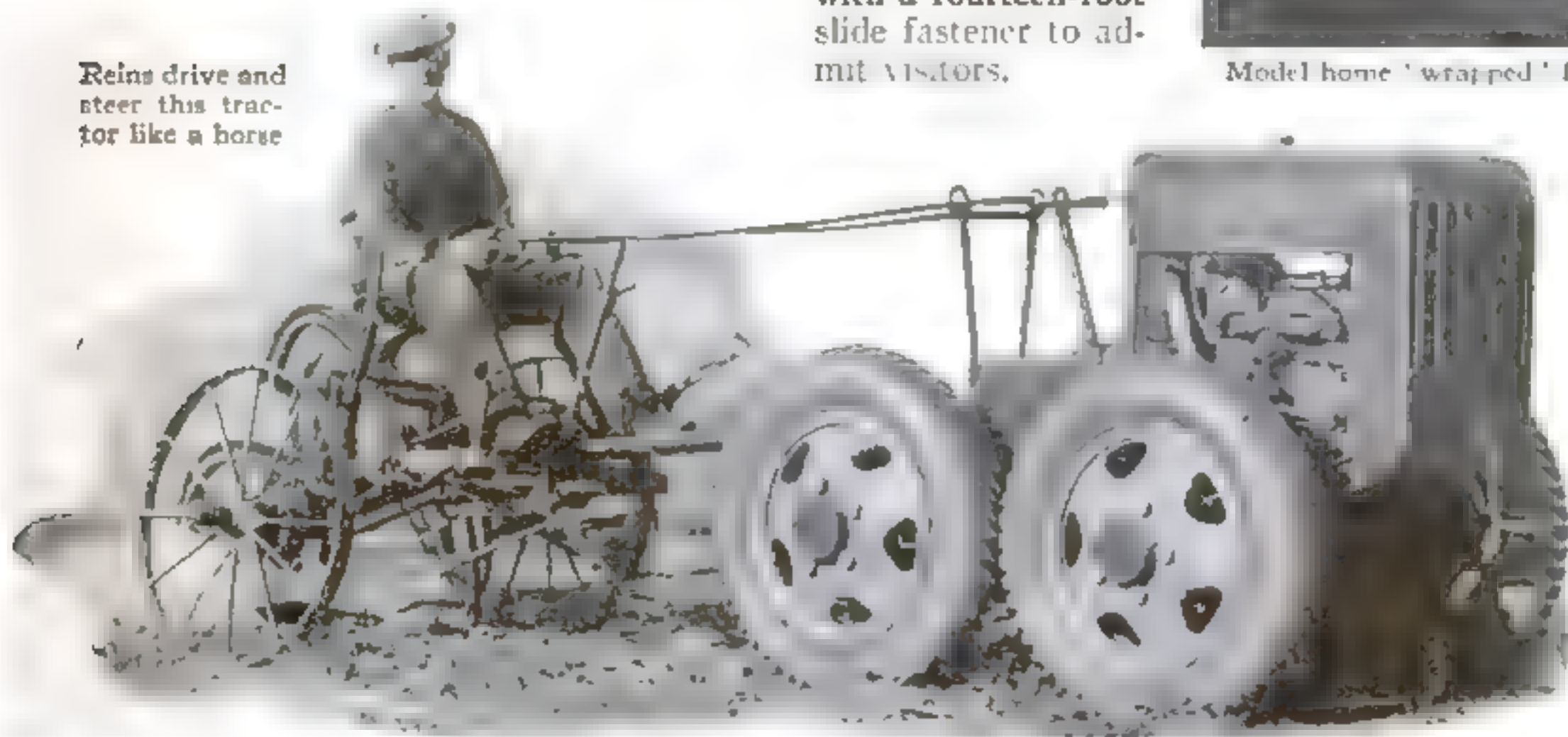
GIFT WRAPPING HELPS SELL NEW HOUSE

BY DOING UP a seven-room "model home" like a box of candy, in a popular transparent wrapping material, a Long Island, N. Y., firm of builders drew a crowd of nearly 6,000 persons to its first public showing. The wrapping consisted of 6,000 square feet of the glistening paper, ornamented with a huge red bow and parted at the door with a fourteen-foot slide fastener to admit visitors.



Model home "wrapped" for inspection. A slide fastener admitted visitors

Reins drive and steer this tractor like a horse



NOVEL FARM TRACTOR DRIVEN LIKE A HORSE

DRIVEN like a horse, a farm tractor devised by two Utah inventors maneuvers obediently in response to his handling of a set of reins. When the straps are slackened, the gasoline-powered machine travels forward. It halts when reined in. A hard pull sets the tractor moving backward, and a tug on one rein or the other steers it to right or left. The reins are attached to levers which protrude from the control mechanism, housed in a metal box mounted behind the tractor's motor.

INVISIBLE MARKS SPOT RANSOM MONEY



Chemical marking on bills being dried. Right, bank teller holding bill under ultra-violet light

DIPPED in a new chemical solution and dried with a hot iron, ransom money is indelibly marked for identification. The preparation leaves no mark that a crook could detect, but the impregnated portion of the bill, which may be simply a strip along the edge, glows brilliantly when a bank teller holds the money under the invisible rays of an ultra-violet lamp.



NOVEL WEEKLY SERVICE KEEPS PHONES GERM-FREE

TELEPHONE subscribers in a number of eastern cities may now avail themselves of a service that undertakes to keep the instruments free of germs. Once a week, a uniformed representative calls, undoes a kit resembling a physician's case, and applies an antiseptic paste that is said to keep the telephone in sanitary condition.

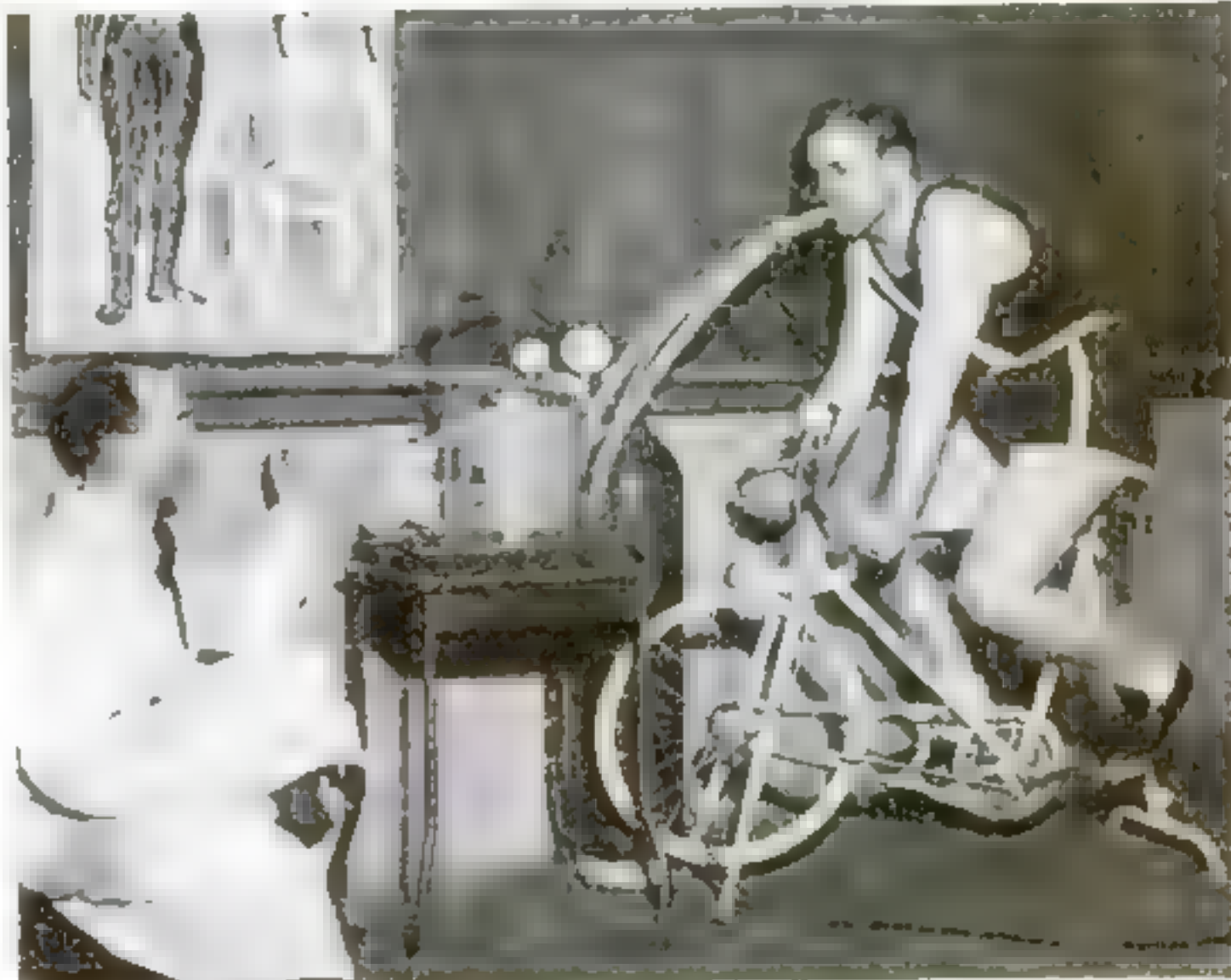


WEIGHTED RUBBER BAG ANCHORS BABY BOTTLE

WEIGHTED with grains of rice or wheat, a new "bean-bag" attachment of rubber keeps baby's nursing bottle within reach, and is not easy to push aside or knock to the floor. The self-service holder also helps to keep the milk warm.

MEN WASTE MORE ENERGY THAN WOMEN

WOMEN apply their energy more efficiently than men, according to tests made at Fordham University in New York City. Breathing through tubes connected to a device called a "metabolator," subjects pedaled bicyclelike machines while experimenters measured their oxygen consumption. Results indicated that men waste ten percent more energy than women.



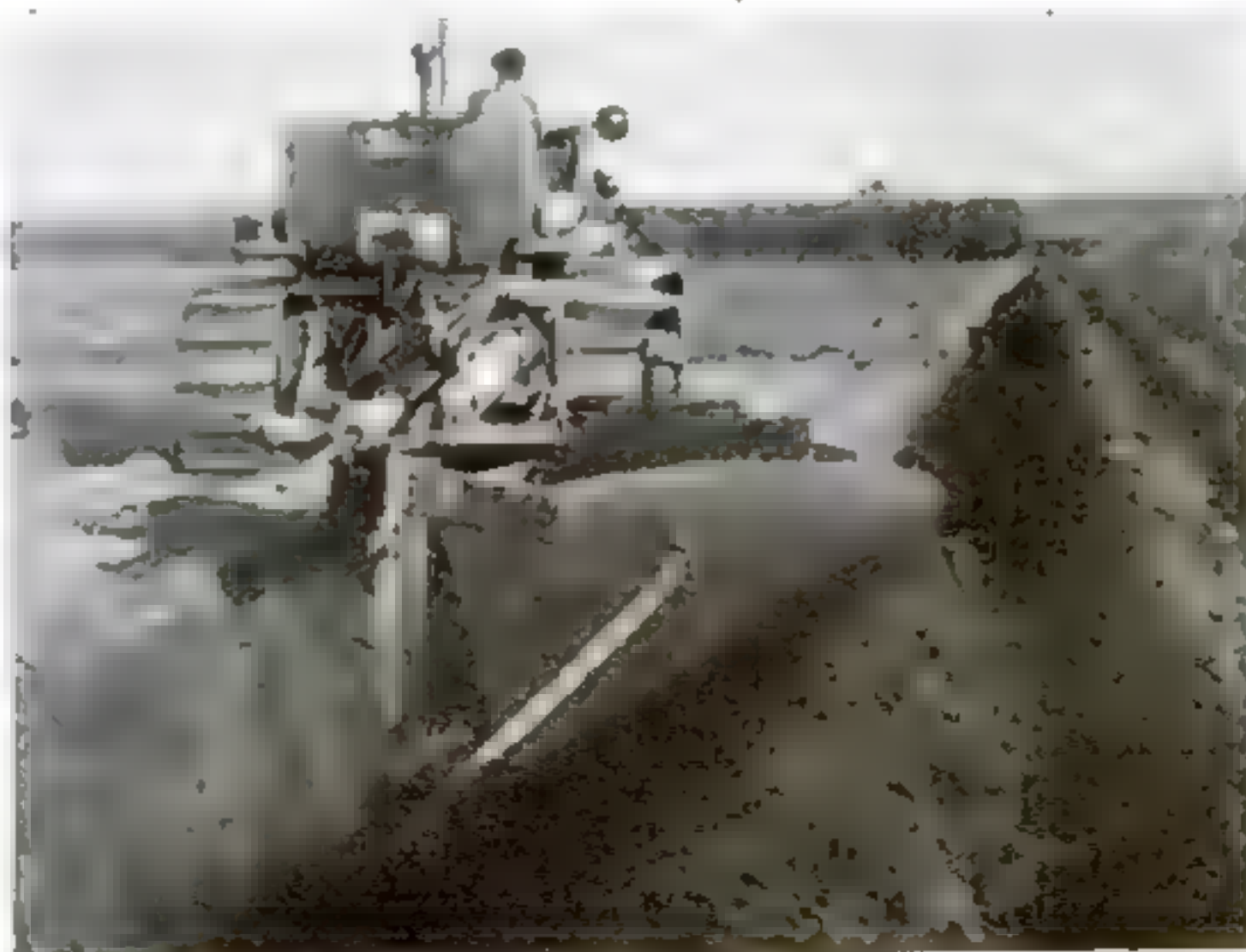
A subject exercising while a special device measures oxygen consumption



This grinder rotates the valve on its seat

NEW VALVE GRINDER IS PNEUMATIC

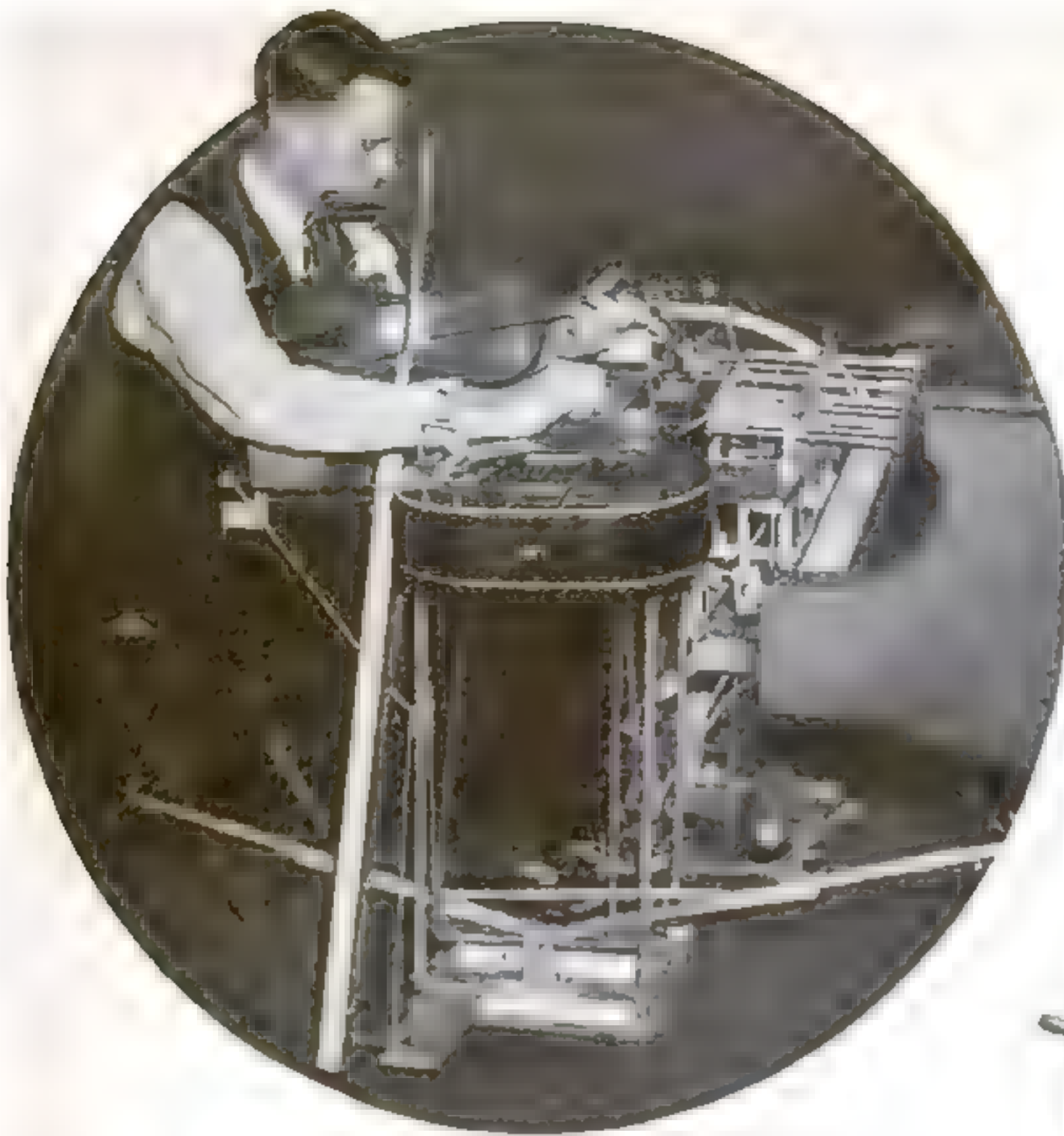
OPERATED by compressed air, a new automobile valve grinder for garages both oscillates and rotates the valve upon its seat, advancing it one sixth of a revolution at the end of each stroke to assure a compression-tight fit completely free of "valleys" and "high spots."



Sand left by floods being turned under the soil in a six-foot furrow

GIANT PLOW RECLAIMS FLOOD LAND

FARM land blanketed with sand by flood waters is being reclaimed for agricultural use with the aid of huge plows like the one illustrated at left. Digging to a depth of six feet, the giant plow-share brings the rich, black soil to the surface and buries the sand. At the end of a furrow, it is lifted from the ground by the use of a powerful hydraulic piston.



PLAYS ELEVEN INSTRUMENTS AT ONCE

ELEVEN separate musical instruments are played simultaneously by Elmer Trudgen, of Blenheim, Ontario, Canada, with the aid of the novel mechanical arrangement shown in the photograph above. Parts salvaged from discarded bicycles, sewing machines, and automobiles were used to make the foot pedals, levers, and other controls which enable Trudgen to coordinate his feet, knees, arms, wrists, and fingers in rendering a musical selection. The instruments are the piano, violin, guitar, harmonica, bass drum, snare drum, triangle, wood blocks, cymbal, cowbells, and chimes.

TEARDROP TRAILER HOLDS ARC-WELDING OUTFIT

A STREAMLINE automobile trailer just constructed by Clyde Hocks, of Milwaukee, Wis., houses a complete arc-welding outfit. Built from scrap parts, the two-wheeled unit makes it easy to transport the gasoline motor and generator necessary to furnish the electric current for the work. A control panel is mounted in the rear of the trailer.



Hitched to a car, this trailer takes arc-welding equipment to the job

FINGERPRINTS TRAP "SLUG" PASSERS

TO TRAP persons who insert worthless metal slugs in turnstiles, slot machines, and coin telephones, an ultra-violet-ray fingerprinting process has been developed.

Since the conventional "powder" method of bringing out latent prints is unsatisfactory for photographing specimens found on metal surfaces, the print is "fixed" with a chemical reagent, and the slug is then soaked in a dye that becomes luminous under ultra-violet light. Placed in a special viewing apparatus, the slug background glows under the invisible light, while the fingerprint stands out in black lines that can be photographed to make a permanent record for checking against prints of suspected persons.



At top, a metal slug is being photographed to record prints as shown above. Right an expert examining slugs for fingerprints



HOME-MOVIE VIEWER TAKES THREE SIZES

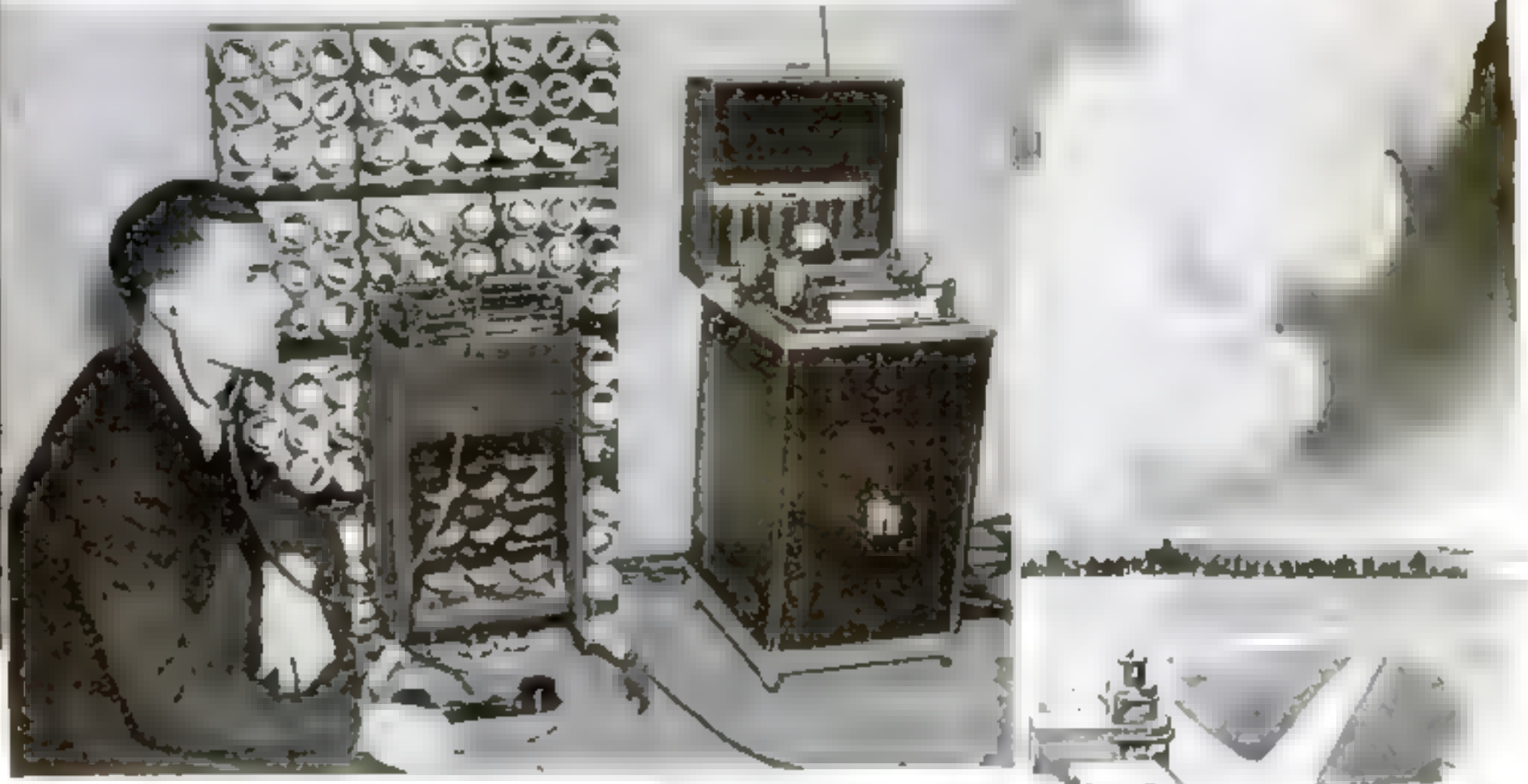
THREE SIZES of motion-picture film are accommodated by a new viewing holder designed for the use of amateur movie makers in examining the quality of their "shots." Removable guides make it possible to insert strips of eight, sixteen, or thirty-five-millimeter film in the device for critical, frame-by-frame study. Changing guides to suit films of different sizes can be accomplished quickly by removing and replacing two small metal pins.

PLANES' RADIO MESSAGES "CANNED" FOR DISASTER RECORD



Airport operator switching in the machine to record his conversation with a pilot. Right recording apparatus and file of dated cylinders

RADIO communications between plane pilots and airport dispatchers are now permanently recorded on wax cylinders by an electrical machine recently installed by the U. S. Bureau of Air Commerce at a California landing field. Reports made by pilots and orders given by dispatchers, kept on file in record form, are thus available to examiners investigating the causes of any accident to a plane.



WINDOW WASHERS TALK IN BROADCAST

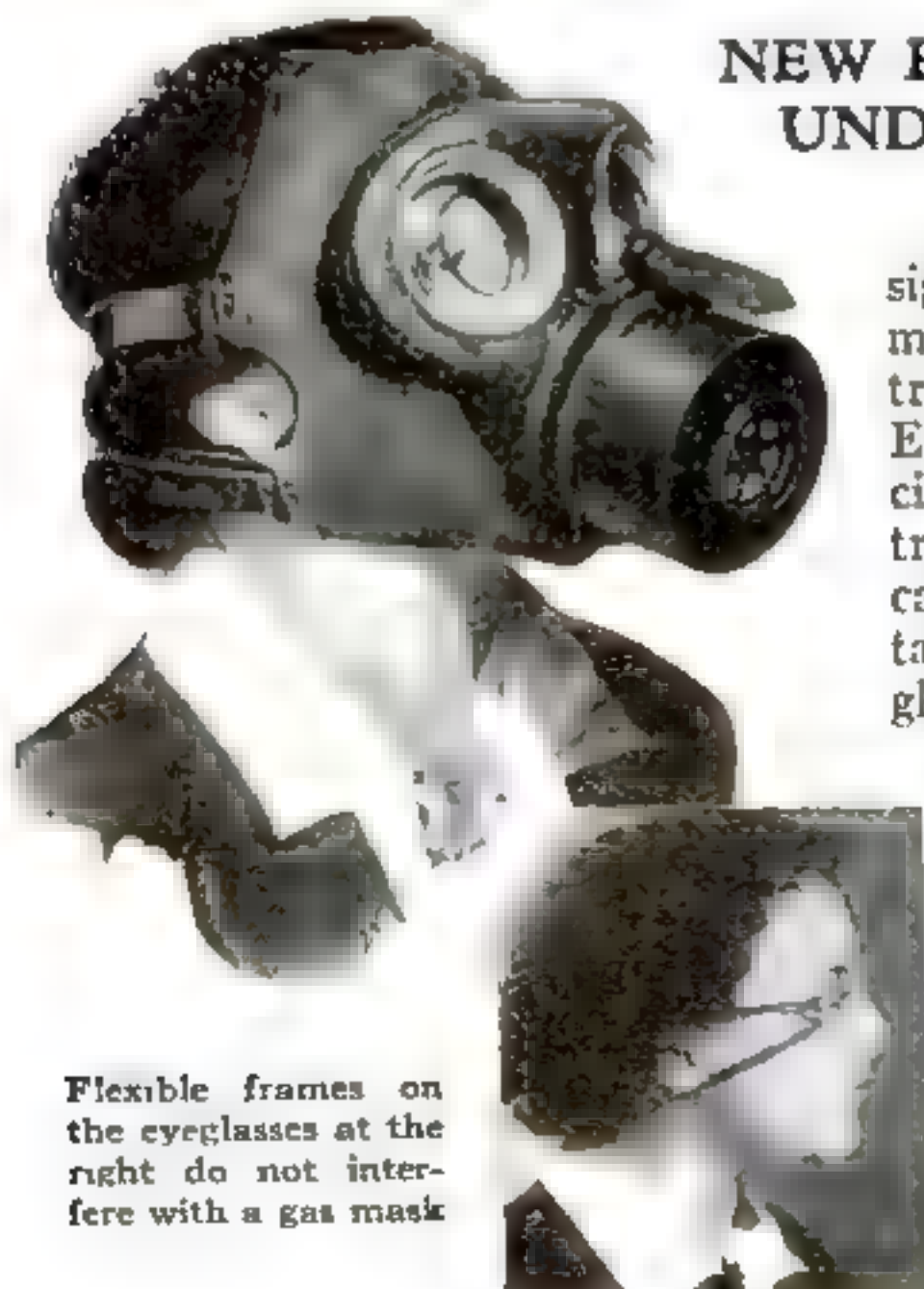
PERCHED on ledges high above the street, two window washers, one in New York and the other in Chicago, communicated by radio recently in a novel broadcast sent out over a nationwide hook-up. With portable transmitters strapped to their backs, the workmen carried on a lively conversation about their work for the entertainment of the listening audience scattered all over the United States.



Window washer in Chicago talking to a fellow worker in New York

HOSE-NOZZLE HOLDER

SPRINKLING a lawn or garden is made easy by a convenient holder for the nozzle of a garden hose. The lightweight unit slides over the hose and has an adjustable metal extension that holds the nozzle at any desired angle. No special hose connections are necessary.



Flexible frames on the eyeglasses at the right do not interfere with a gas mask

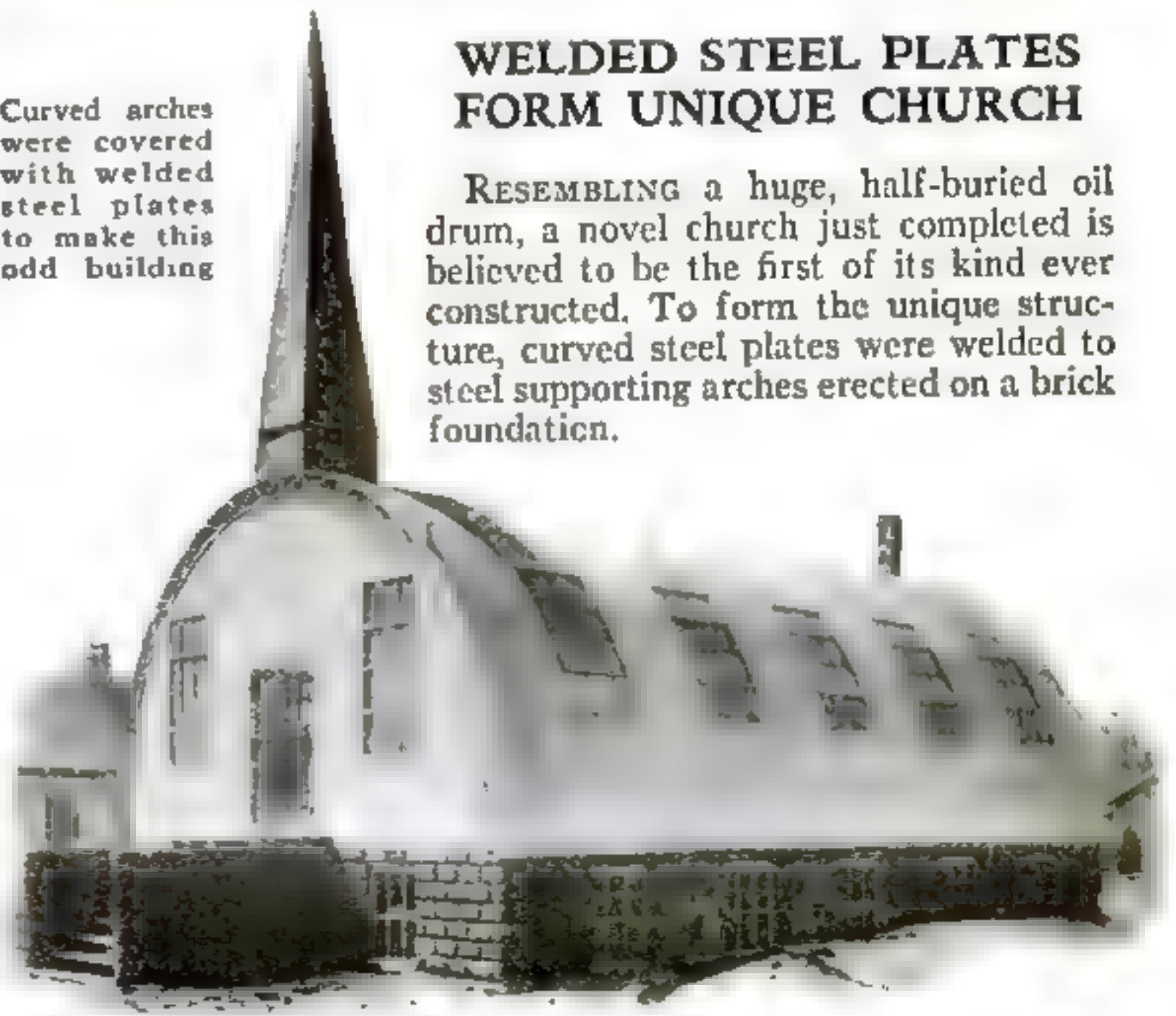
NEW EYEGLASSES FIT UNDER GAS MASK

EYEGLASSES specially designed for use with gas masks have just been introduced to the public in England, where the entire civilian population is being trained to protect itself in case of wartime gas attacks. Unlike conventional glasses, whose rigid frames do not always fit close to the head and might cause a slight leak when a mask is put on, the new spectacles have flexible frames made of elastic tape, which fit closely over the side of the face. The flexible frames are easily adjusted.

Curved arches were covered with welded steel plates to make this odd building

WELDED STEEL PLATES FORM UNIQUE CHURCH

RESEMBLING a huge, half-buried oil drum, a novel church just completed is believed to be the first of its kind ever constructed. To form the unique structure, curved steel plates were welded to steel supporting arches erected on a brick foundation.



Master Builder

. . . . FRED OFFENHAUSER MAKES ENGINES

THIRTY-TWO grim drivers faced the starter's checkered flag, awaiting the signal to roar away in the 500-mile grind around the Indianapolis, Ind., Speedway which was to dump fame and fortune into the winner's hands. The year was 1935. Among the racers were Kelly Petillo and Wilbur Shaw, both using motors built by an unknown western mechanic. Petillo won, and Shaw placed second.

Twelve months later, thirty-two racing-car pilots again faced the same black-and-white flag. Now, eleven drivers had turned to that obscure builder of speed, for power plants which they hoped would bring them a share in the prizes. One of these, Lou Meyer, eased through the field to victory, while three others beat the jinx of accident that dogs every entrant in the premier race classic to place third, sixth, and seventh.

Just a few days ago, sixteen of America's most skilled and daring drivers—half of the total starting field—converged on Indianapolis from East and West in late May, ready to test their skill on Memorial Day behind custom-made motors cast, machined, and assembled by the man who two years ago was known only to the racing fraternity, and who never in his life has driven a racing automobile. Only once has he ridden with a racing driver, an experience he declares he never will repeat.

A stocky, baldish mechanic named Fred

Offenhauser supplied the speed that drove Petillo and Meyer into victories, and thereby established himself as the No. 1 builder of racing motors. In his modest machine shop on a quiet street in Los Angeles, Calif., Offenhauser builds the sleek engines of bronze, aluminum, and steel whose speed and stamina have carried thirteen drivers through two 500-mile races without failure.

Today, practically all the leading pilots, including Petillo, Shaw, Meyer, Bill Cummings, Chet Gardner, Emery Collins, Ralph Hepburn, Lou Moore, Phil Shafer, George Lyons, and Floyd Roberts, turn to Offenhauser for their motors.

Unknown two years ago, today toasted by racing drivers everywhere as the world's premier builder of speed—that is the summary of his amazing rise to motor prominence. But to pick up the thread of this man's story, we must turn the clock back nearly a quarter of a century.

Offenhauser went to work in 1913 for Harry Miller, who later was to build more

winning racing engines and cars than any other man in the history of the sport. For three years he built carburetors in Miller's small Los Angeles plant. Then, in 1916, Bob Burman, who had gone west to enter a series of road races at Santa Monica, burned up the motor in his French Peugeot. To secure new parts from Paris was impossible, and Miller dumped the job of repairing the ailing power plant in Offenhauser's lap.

The mechanic fixed up the engine satisfactorily. Miller became interested in racing, and soon Offenhauser found himself superintending the building of the famous Miller engines and cars. Barney Oldfield bought the first, and within a short time other track and road-race stars of the day—Tommy Milton, Billie Arnold, Ralph De Palma, Harry Hartz, Fred Frame, and Peter De Paolo—changed from various motors and cars to Miller's products.

For twenty-one years, Offenhauser worked with Miller. During that period

AN ACE OF THE
ROARING ROAD
Lou Meyer, a three-
time winner of the
Indianapolis Speed-
way classic, trying
out his entry for
the great 1937 race

By ANDREW R. BOONE



of Speed

FOR RACING CARS

he superintended the building of seventy-five engines, each hand-made and fitted like a kid glove. "Harry Miller spent plenty of money on research, sometimes more than he made on sales," Offenhauser told me. "Consequently, I was learning what materials to use and how to put them together so they would not break down."

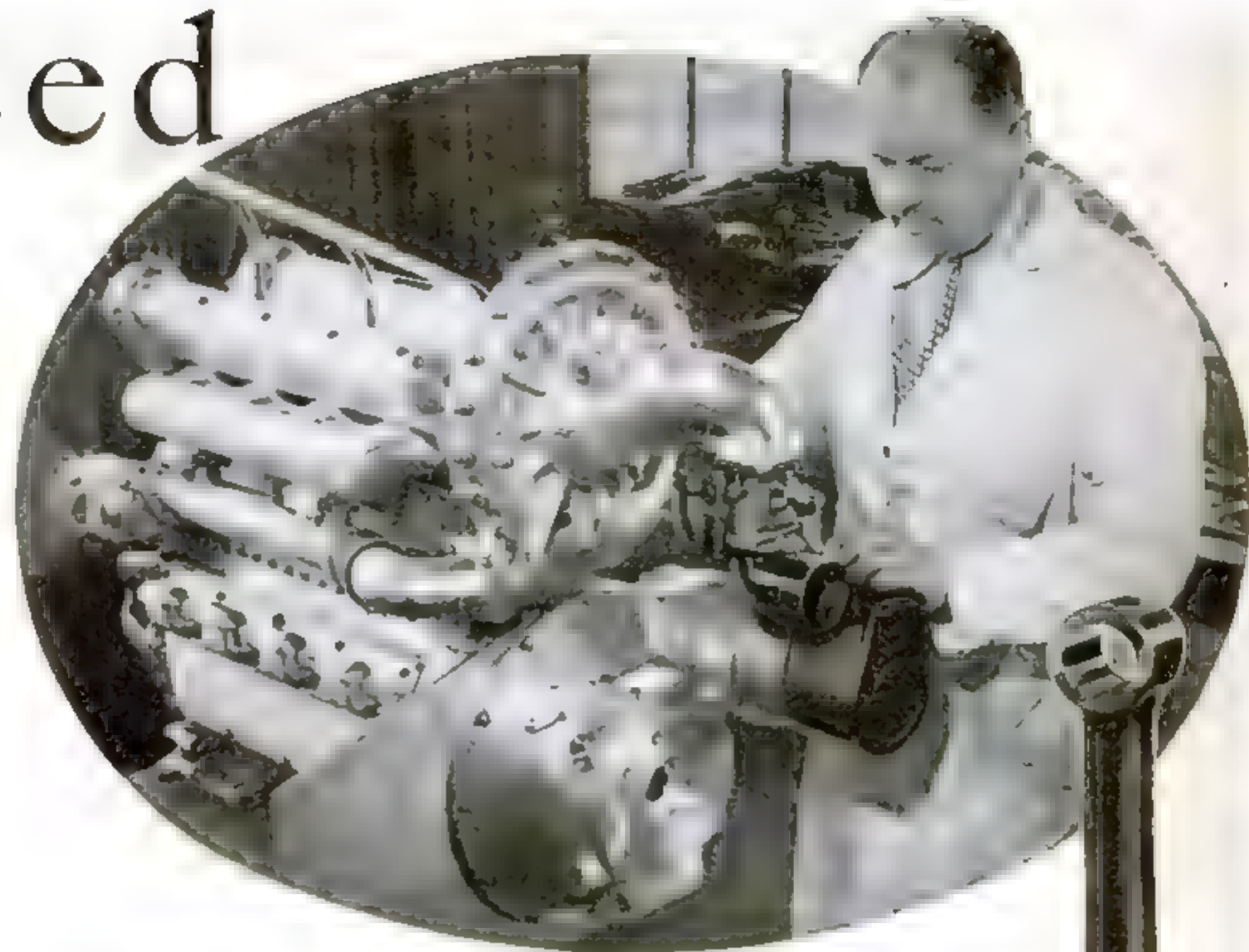
Miller quit the game in 1933, and his veteran mechanic bought some of his machinery, set up his own shop, and announced his readiness to take up where Miller had left off. Immediately he plunged into further research, decided to increase the weight of some parts for greater strength, changed the valve timing and port openings to speed up their action, and obtained the newest products of metallurgy so that the heat generated during fast running might be quickly dissipated and the parts would not crack under terrific pressures.

Petillo, then comparatively unknown, but having faith in Offenhauser's ability to build engines that could "take it," left his job in southern California in the autumn of 1934 and plunked his life savings, \$5,000, into the chassis of a racing car. Some of this money had come to him as prizes at the old Ascot Speedway, near Los Angeles, the rest from small wages earned by driving a fruit truck.

"I'll furnish the car if you'll build a motor," he said to Offenhauser. "But I can't pay unless I win."

Offenhauser, anxious to determine whether the skill he had been slowly acquiring really could be converted into the reliability and speed demanded of a racing engine, quickly agreed.

Some months later, Petillo rolled his car onto the speedway for his first qualifying round. Track rules required 105 miles an hour, but Petillo burned up the pavement at 121. On returning to the pits, it was found the motor had burned too much gasoline. Offenhauser checked that trouble, and Petillo again roared around the oval to test the car. On the third lap, the engine became overheated



THE MAN BEHIND THE CAR Fred Offenhauser at work in his shop in Los Angeles, Calif. Right, a piston and connecting rod from one of his new engines



and one of the connecting rods broke.

Fearful that other rods would crack, Offenhauser telephoned to Los Angeles for a reserve engine, one on whose building he had gambled for just such an emergency as this. Forty-eight hours later, the plant arrived by air. Night and day, mechanics labored over the new installation, completing it barely five minutes before the time for trials expired. Petillo qualified, and next day, not conceded even an outsider's chance by the experts, the little Italian pounded around the 2½-mile brick track at an average speed of 106.24 miles an hour, not only setting a new track record for the 500 miles, but also collecting \$35,000 as first prize, lap awards, and for testimonials.

Offenhauser modestly disclaims any superiority for his motors. "Any good motor will carry through a race," he says. His record in the brief period since Petillo's throttle, jammed to the floorboards, set that dazzling track record at Indianapolis, demonstrates that it is the "little things"

that snatch almost certain victory from many drivers.

"Petillo had his troubles," Offenhauser remarked, "but"—knocking on the corner of his desk—"not one of my engines has failed during a race. Some of the boys have run out of gas, others had trouble with the chassis. . . ."

"What is the most common trouble?" I interrupted.

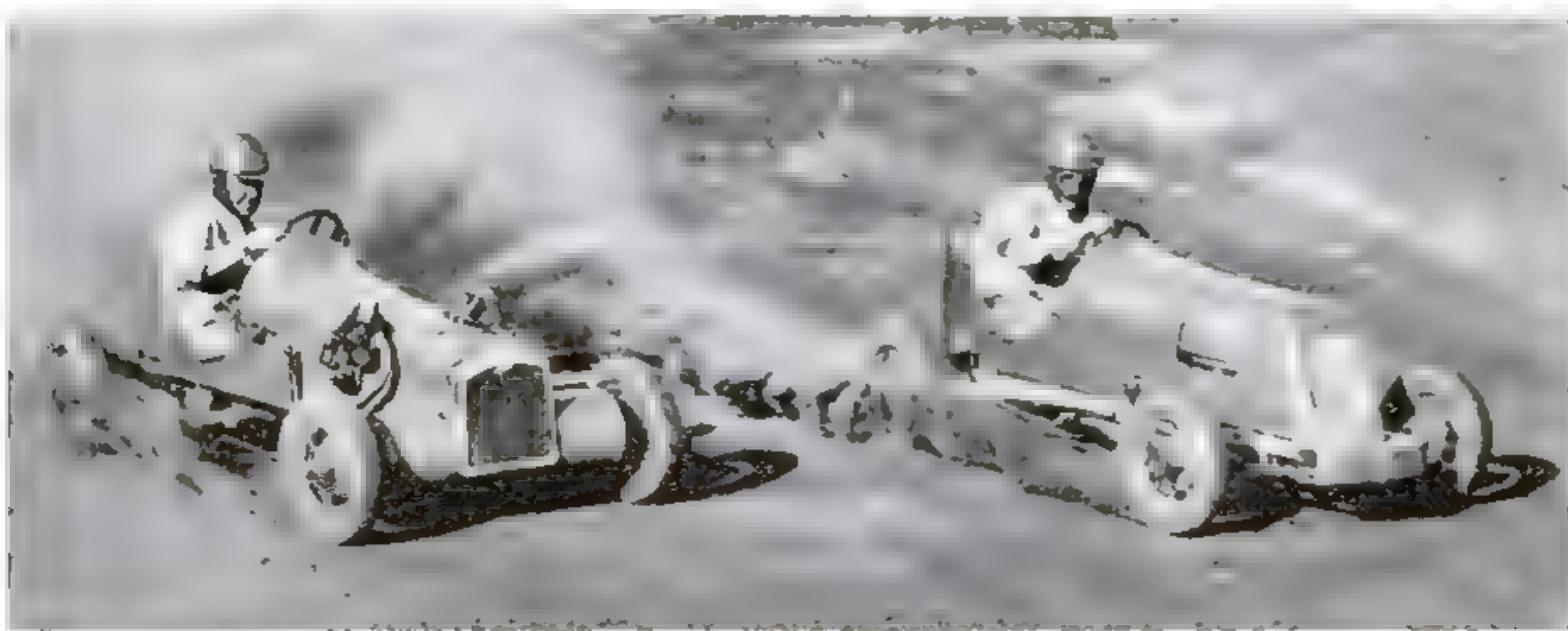
"Hard to say. One year, Mays was leading by a comfortable margin, when a spring shackle broke. This was entirely unforeseen, yet it forced him out. He couldn't stand the pounding.

"Last year, Mays was out in front again. It looked as though he would win, but a cotter pin fell out of his carburetor control. Mays pulled into the pits to have

the pin replaced, and Shaw moved into the lead. He was running well ahead of the field, but the rivets on his hood broke. That let him out, and soon Meyer jumped ahead, to win with a sizzling record three miles faster than Petillo's speed the year before.

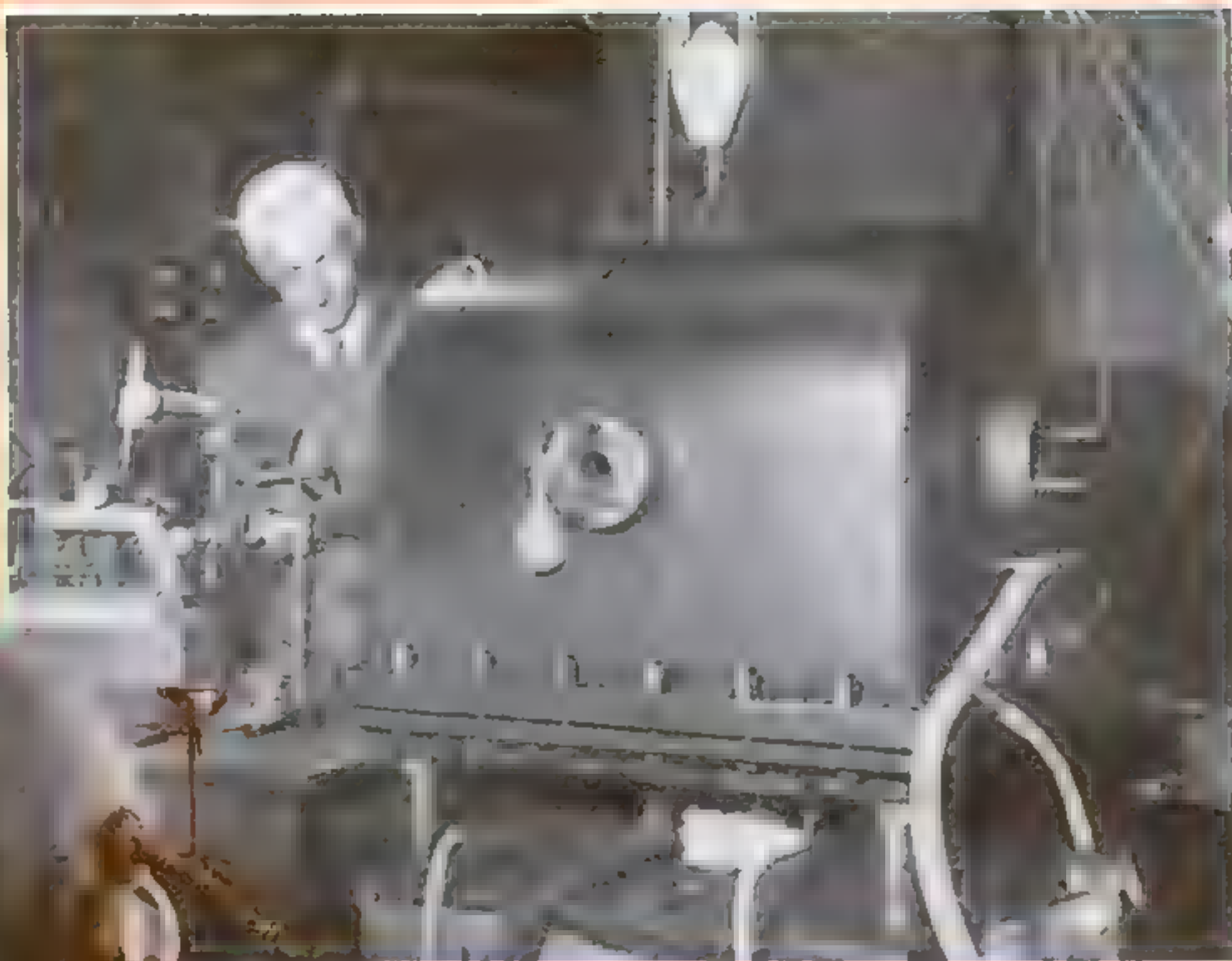
"Say, did you ever have \$30,000 snatched right out of your hand? If you had, you could understand how those boys felt."

But those are (Continued on page 107)



Midget racers in a dirt-track speed contest. Offenhauser also builds engines for the dare-devil drivers of this new sport

Dr. Arthur S. King with the electric furnace in which he re-creates the conditions existing on distant stars. Some of his discoveries point to the realization of the dreams of the ancient alchemists



MAN-MADE

★ ★ A star factory where celestial bodies are reproduced as tiny masses of white-hot vapors, like those in the stars themselves, is one of the strange laboratories clustered about the great observatory at Mount Wilson, Calif. With the aid of special apparatus, Dr. Arthur S. King assays the stars, reads the temperatures of their surfaces, charts their magnetic fields, and sometimes even detects the presence there of freak atoms resembling the "heavy" hy-

drogen that is found in "heavy" water.

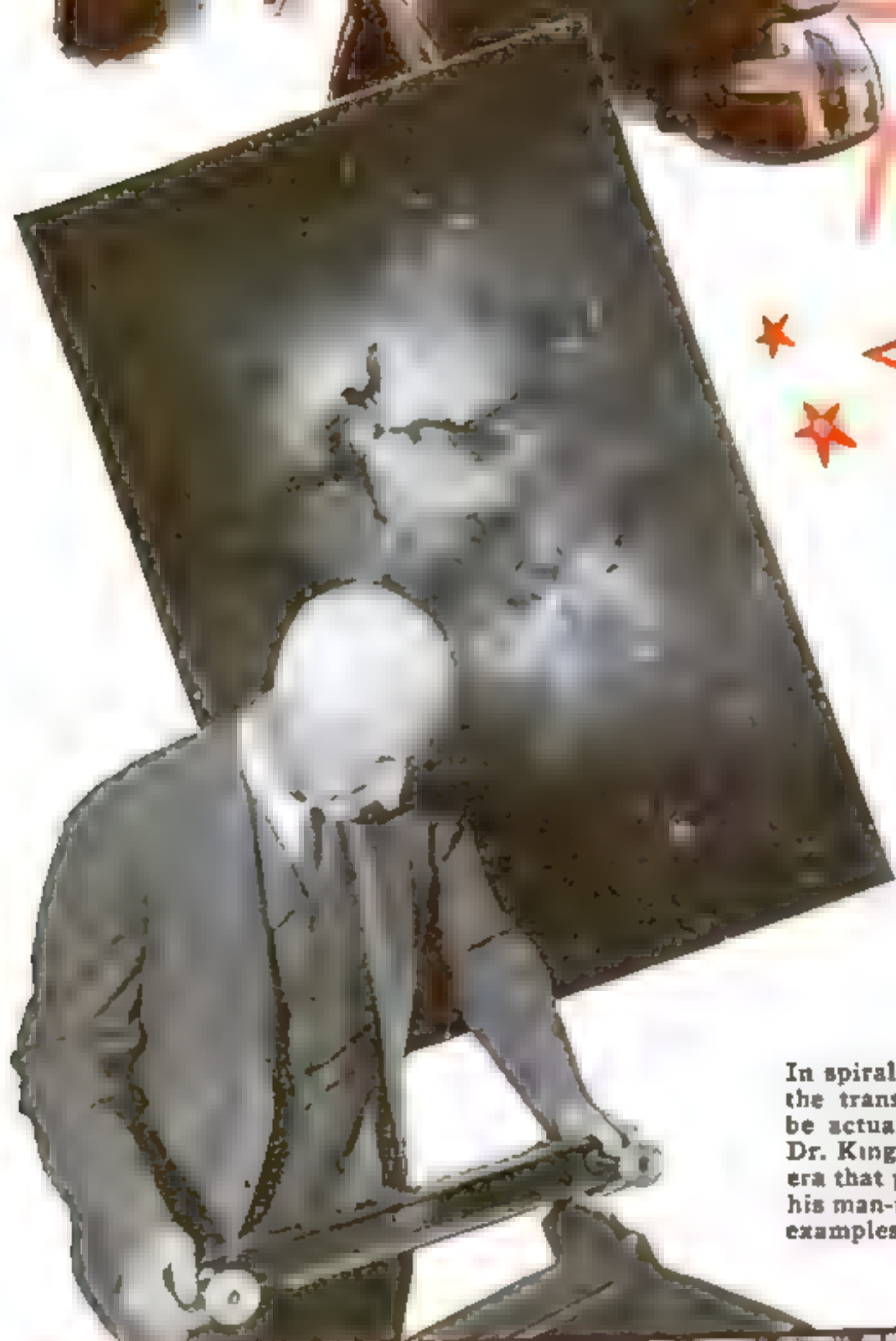
To create a miniature star, Dr. King places a tiny pinch of certain elements in the center of a hollow graphite tube, snaps it into his electric furnace, and sends a terrific electric current of 1,000 to 2,000 amperes surging through, heating it until it glows white-hot. Out of the tube comes light from the luminous vapors to which its contents have been transformed. It passes to a metal mirror ruled with myriads of fine parallel scratches, and is reflected from its polished surface as a spectrum of rainbow colors—deepest red to violet, and on into the invisible "black" rays of ultra-violet. A camera records the spectrum as a parade of tiny vertical lines, each representing one of the chemical elements present in the synthetic sun.

Beginning at a strong, white heat—say, about 1,200 degrees centigrade—Dr. King gets a plate marked by only a few scattered lines. But as he turns the current higher, the glowing material in the tube radiates more fiercely and new lines come out, one by one, like stars at nightfall. When the spectrum lines from his miniature star exactly match the pattern of some real star as recorded with the great telescope at Mount Wilson, Dr. King knows he has exactly duplicated the conditions on the star itself.

No thermometer could withstand the fury of the blazing furnace, and its temperature can be measured only by a novel optical instrument. Dr. King turns a knob, electrically heats a wire until its glow exactly matches the tiny "star" in color, then consults a chart to interpret the corresponding temperature.

Top heat for the furnace is 3,500 degrees centigrade—hot enough to melt any of the metals, even tungsten. Within this range,

In spiral nebulae, far off in space, the transmutation of metals may be actually taking place. At left, Dr. King is loading a special camera that photographs the spectra of his man-made stars. Below are five examples of the pictures it makes





A spectacular flare-up on the sun. The white spot indicates the relative size of the earth.



This giant electromagnet is used in duplicating and measuring the strength of the magnetic whirl in a sun spot as photographed through the 100-inch telescope with spectrograph lens at left.

SUNS 'STAR FACTORY'

Dr. King can duplicate the cool red stars and some of the whiter ones, like our own sun. But the white and bluish-white stars have a peculiarity all their own. Their spectra contain certain groups of lines showing that star atoms have been stripped of some of their electrons, thus virtually becoming brand-new substances. To match this terrific, atom-shattering temperature, Dr. King uses a high-tension electric spark, which literally rips off electrons and sets them into violent motion, thus reproducing these flaming, far-away stars like Sirius.

Many an astronomical mystery has been solved in Dr. King's star factory. On one occasion, astronomers were puzzled by a large bunch of very fine lines in a star's spectrum, which did not belong to any known element. Were they caused by some mysterious substance not existing on earth? Dr. King experimented to find a match for the puzzling lines, finally produced it with white-hot vapors of cyanogen—a combination of carbon and nitrogen—and proved that the star's atmosphere contained swirling vapors of this deadly gas, used on earth to disinfect ships' holds.

Are sun spots hotter or cooler than the sun itself? Scientists disagreed on this question until Dr. King attacked the problem. With a telescope trained on individual spots, Mount Wilson astronomers obtained sun-spot light containing scores of spectrum lines much stronger than those from the rest of the sun. Guided by this "recipe," Dr. King put the corresponding elements into his furnace and learned that lower temperatures gave the profuse lines—proving beyond doubt that sunspots are cool areas in the sun's superheated surface.

Long ago, Dr. George Ellery Hale of

Mount Wilson had observed that sometimes a single spectral line from a sun spot would be split into twins, or even triplets. Suspecting the cause, Dr. King took fragments of some of the metals found in the sun, used them as electrodes of a spark jumping between the poles of a powerful electromagnet, and produced identical multiple lines. He then varied the strength of the magnet until he exactly matched the split lines, thus duplicating—and measuring—the strength of the magnetic whirl at the heart of the sun spot.

While creating artificial stars in his laboratory, Dr. King found that certain photographic plates showed, in addition to the wide band representing the plentiful element carbon, a fainter band evidently belonging also to carbon. In collaboration with Prof. R. T. Birge, of the University of California, he discovered that the phantom lines belonged to a brand-new form of carbon—an "isotope," or freak atom, just a little heavier than the normal carbon atom. Analysis of samples from widely separated regions showed this "heavy" carbon to be sprinkled throughout the earth, mixed with ordinary carbon in proportions of about one part in 200. But when he sought the mysterious substance elsewhere in the universe, he found it still more plentiful in certain of the red stars.

Turning now to the only tangible source of material from outside the earth, Dr. King next vaporized fragments of meteorites in his furnace. He found not only the heavy carbon he was seeking, but also some of the rare elements in much more abundant quantities than on earth.

Another striking discovery soon promised to throw new light on a scientific mystery of long standing. Astronomers have divided meteorites into two types—stony and nickel-iron—but never have known why some fragments seem to be hybrids, with the crumbly stone shading into lumps of a tough, malleable alloy of nickel and iron. But soon Dr. King noticed a startling coincidence.

In the laboratories of the atom-smashers, substances have been broken down, by the tremendous onslaught of deutron "machine guns," into other substances, as was dreamed by alchemists of old. Strangely, Dr. King noticed, metals such as those found in the nickel-iron meteorites, have broken down into elements found in the stony meteorites. Now scientists are wondering if miracles of transmutation are not wrought far out in the depths of space. This is one of many questions that await solution in laboratories such as Dr. King's, where tiny man-made stars are yielding up one after another of nature's treasured secrets.

**Tiny Masses of White-hot Vapor, Flaming Furiously
In an Electric Furnace, Enable Astronomers To Study
Conditions Existing Millions of Miles Away in Space**

By STERLING GLEASON

HARPOON GUN FOR SWORDFISH. Peering through a telescope sight, an angler aims this gun at his quarry and pulls a trigger. Compressed air hurls the harpoon at the fish, which can then be played as usual with rod and reel

New Inventions FOR SPORTSMEN



GIANT REEL. More than a mile of heavy line can be unwound from a monster reel just developed for deep-sea fishing. Made of aluminum, the reel weighs almost sixty pounds and has a built-in seat to accommodate the rod

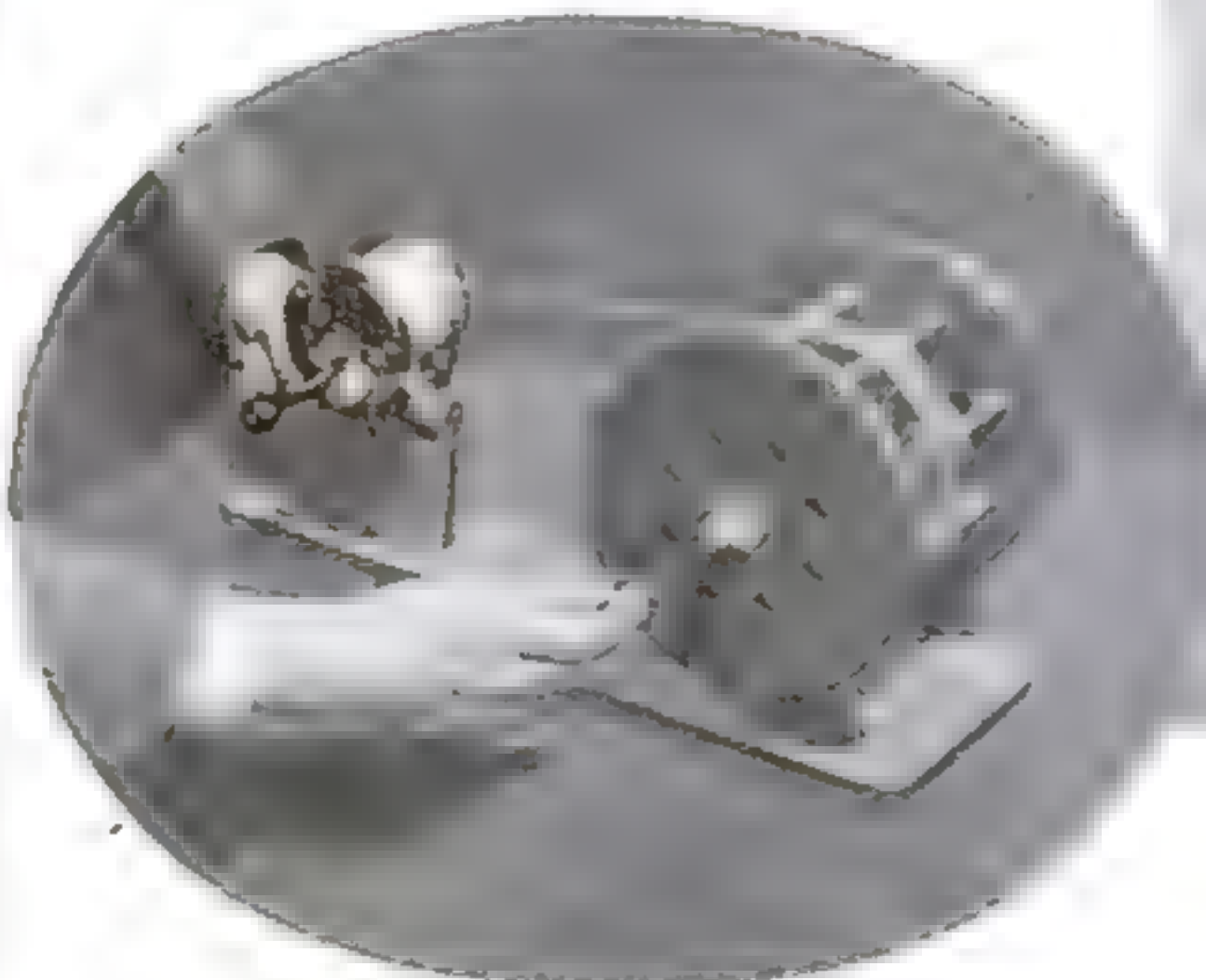
WHAT'S new in sporting equipment? Each year, as the fishing and hunting seasons roll around, inventors in all parts of the country come forward with new and improved devices to meet the ever-changing needs of American sportsmen. On the west coast, fishermen demanded a more efficient method of catching giant swordfish, and a new compressed-air harpoon was devised. Eastern anglers felt the need of a reel capable of unwinding 6,000 feet of heavy line, and a veteran tackle maker produced a sixty-pound aluminum reel designed to match the power of Atlantic tuna and shark. Rustproof holsters, simplified driers for wet line, sand spikes for holding the rods of surf fishermen—these examples, illustrated in the accompanying photographs, are representative of this year's answers to the demand of sportsmen for better and more efficient equipment.



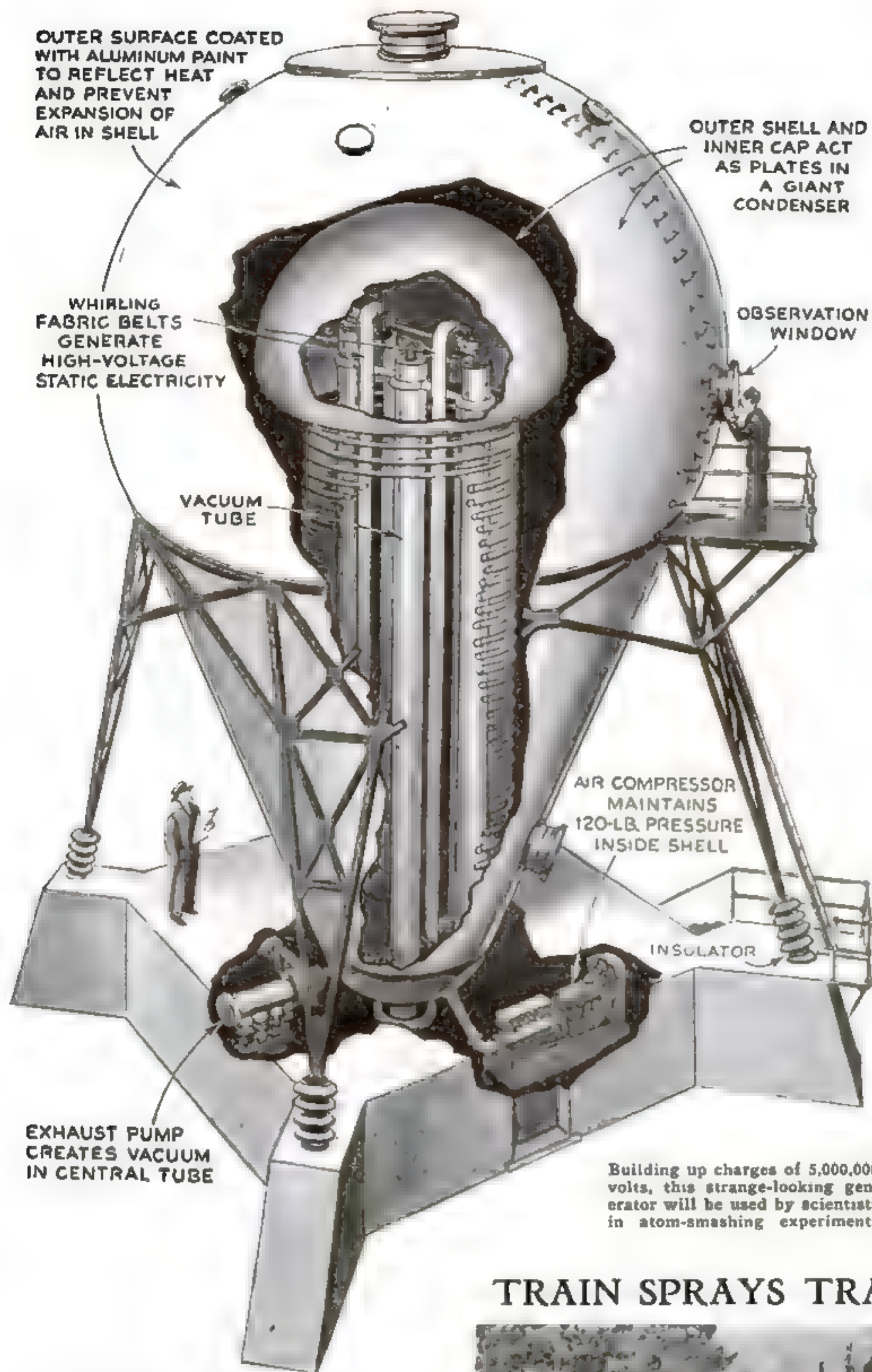
NEW HOLSTER DRIES PISTOL

The fluffy fleece lining of this novel holster removes moisture from a pistol placed in it. Firearms used in the rain or exposed to salt spray are thus protected from rust. Such holsters are available in many sizes

LINE DRIER. A hand grip and handle on the line drier pictured below make it easy to use in cramped quarters. The reel is fastened to a seat on the base of the drier, exactly as it is attached to the rod



SAND SPIKE HOLDS ROD. Made of rustless metal, a new sand spike for beach fishing comes apart in sections. Flat, winglike flares keep it from twisting, and a bracket is provided for a lantern. The butt of the rod fits in a socket



Huge Generator To Smash Atoms

SUGGESTING a gigantic metal pear, placed small end down, the latest generator for use in atom-smashing is being constructed by engineers at the Westinghouse laboratories, East Pittsburgh, Pa. Thirty feet in diameter, it will tower almost as high as a four-story building. Fabric belts, whirling at high speed, will build up charges of 5,000,000 volts and more for use in bombarding atoms. To provide additional insulation for the generator, the air in the chamber surrounding the vacuum tube will be under a pressure of 120 pounds to the square inch. A window in the shell is provided for observers.

TRAIN SPRAYS TRACKS TO KILL WEEDS



The spray train in operation. Note inverted troughs that protect rails

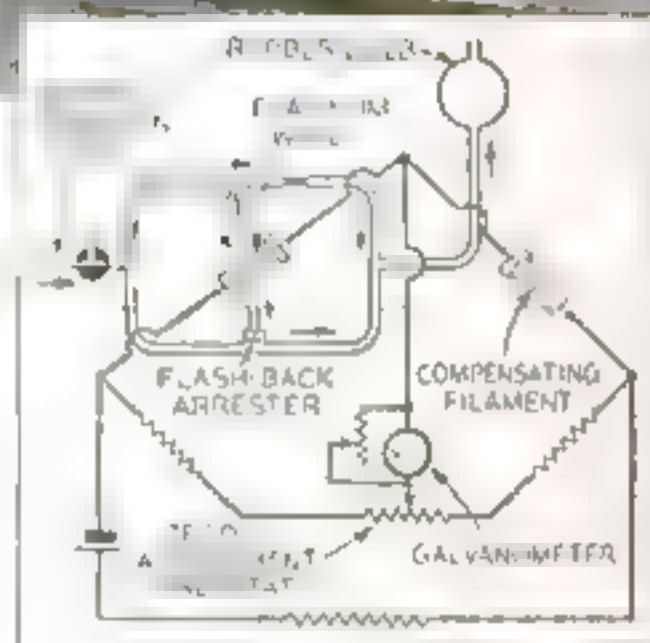
IN SIXTY minutes, twenty miles of railroad track can be treated with weed-killing chemicals by means of a new high-speed spray train recently introduced in England. Three locomotive tenders are joined together to hold the 11,500 gallons of water and chemicals carried by the train. About 400 gallons of the mixture treats one mile of track, nine jets shooting the spray downward as the train speeds along. Special shields, like inverted V's, protect the steel rails from corrosion by the chemicals.

METER GAUGES STRENGTH OF EXPLOSIVE VAPORS



Engineer testing air from a storage tank with the new safety device

Vapor heats a filament and increases its resistance to electricity



SIMPLY by pressing a rubber bulb, safety engineers can now determine exactly the percentage of explosive vapor in the air within oil-storage tanks and other places where fumes are likely to accumulate. The bulb sucks samples of the air into an instrument in which they pass across a platinum wire. Reaction to the gas heats the wire, increasing its resistance to the flow of electric current. A galvanometer dial is arranged to gauge this resistance, and thus indicates the amount of vapor present.



SHOOT FIREWORKS FROM EIFFEL TOWER

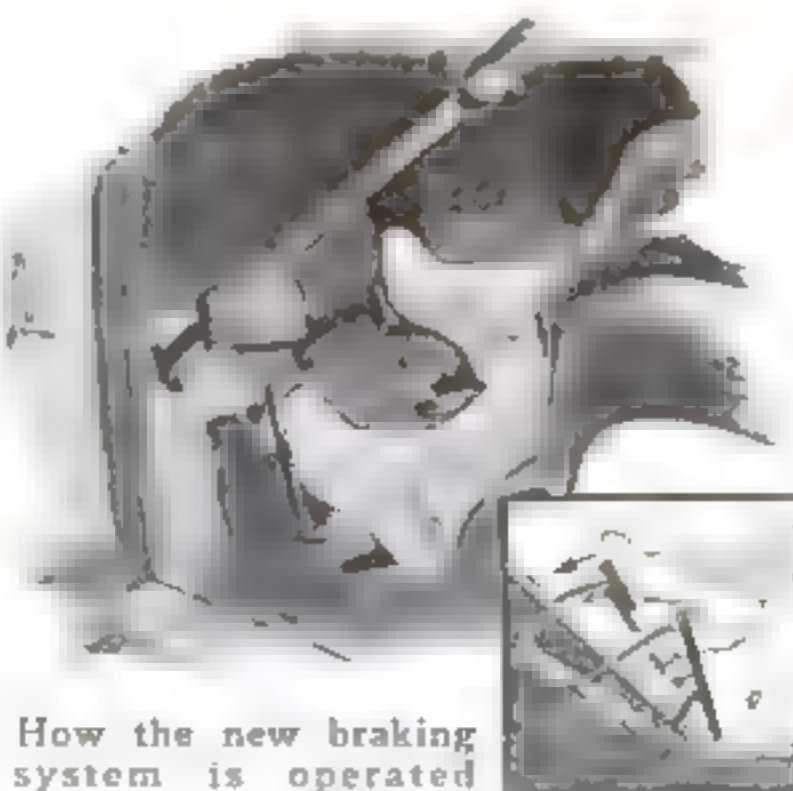
SHOWERING down over the fairgrounds in streamers of light, spectacular fireworks displays from the top platform of France's famous Eiffel tower form an outstanding feature of

the International Exposition that recently opened in Paris. As a rocket bursts in the striking photograph above, it illuminates the buildings erected for the exposition.

ELECTRIC FOOT WARMER

PLUGGED into a wall socket, a new electric rug is useful for keeping the feet warm. Thermostatically controlled, so that it cannot overheat, the electric foot warmer is designed for use by convalescing patients in hospitals and sanitariums.

This electric warmer can be plugged into a wall socket



How the new braking system is operated

NOVEL PEDAL SYSTEM CUTS BRAKING TIME

OPERATED with the left foot, the accelerator in a new automobile braking system is placed between the clutch and brake pedals. To be always ready for emergencies, the driver's right foot rests on the brake pedal while driving. When the brakes are applied, a lever forces the accelerator pedal to the "off" position.

PICTURES COPIED ON MARBLE WITH ODD OPTICAL DEVICE



Using a homemade camera lucida consisting of a combination of prisms and mirrors, A. H. Bumstead of Washington, D. C., reproduces old photographs as marble bas-reliefs. Looking through one of the prisms, Bumstead obtains an accurate reflection of the picture on the marble slab. Thus guide marks and lines on the original can be readily located and carved on the marble surface.



HOLDER TILTS ENLARGER EASEL TO CREATE TRICK EFFECTS

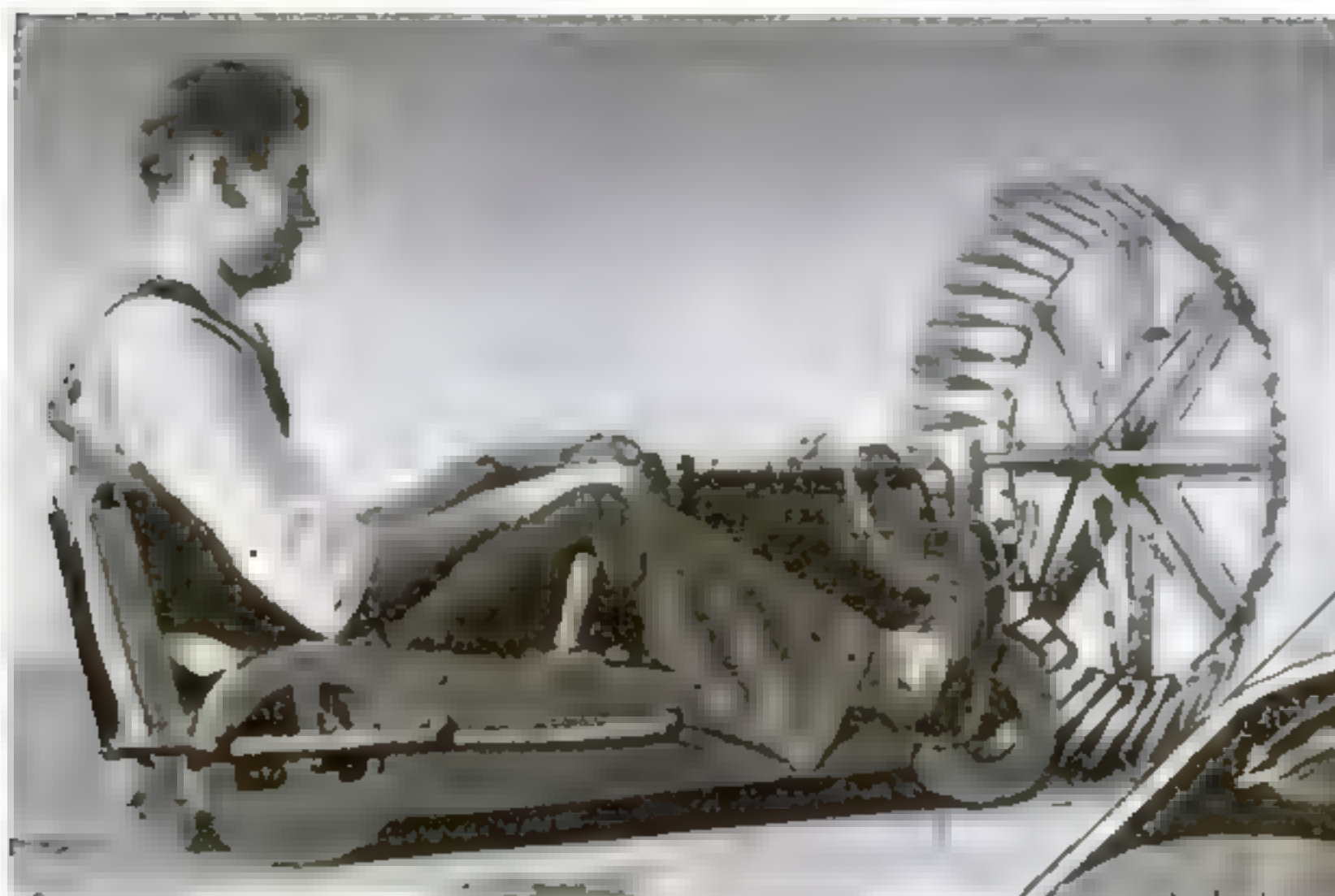
AS AN aid to producing trick effects while enlarging photographs, a tilting easel platform is now available to camera fans. A ball-and-socket joint permits the easel holding the sensitive enlarging paper to be tipped at any desired angle. In this way, various distortions, such as lengthened or broadened heads, can be produced.

ROWING COURSE IS WAVEPROOF

CURVED side walls being built into the rowing course for the 1940 Olympic Games in Japan. have been designed to eliminate rough water. Their concave shape, it is hoped, will focus the waves to a single point where they will counteract each other and reduce the agitation of the water.



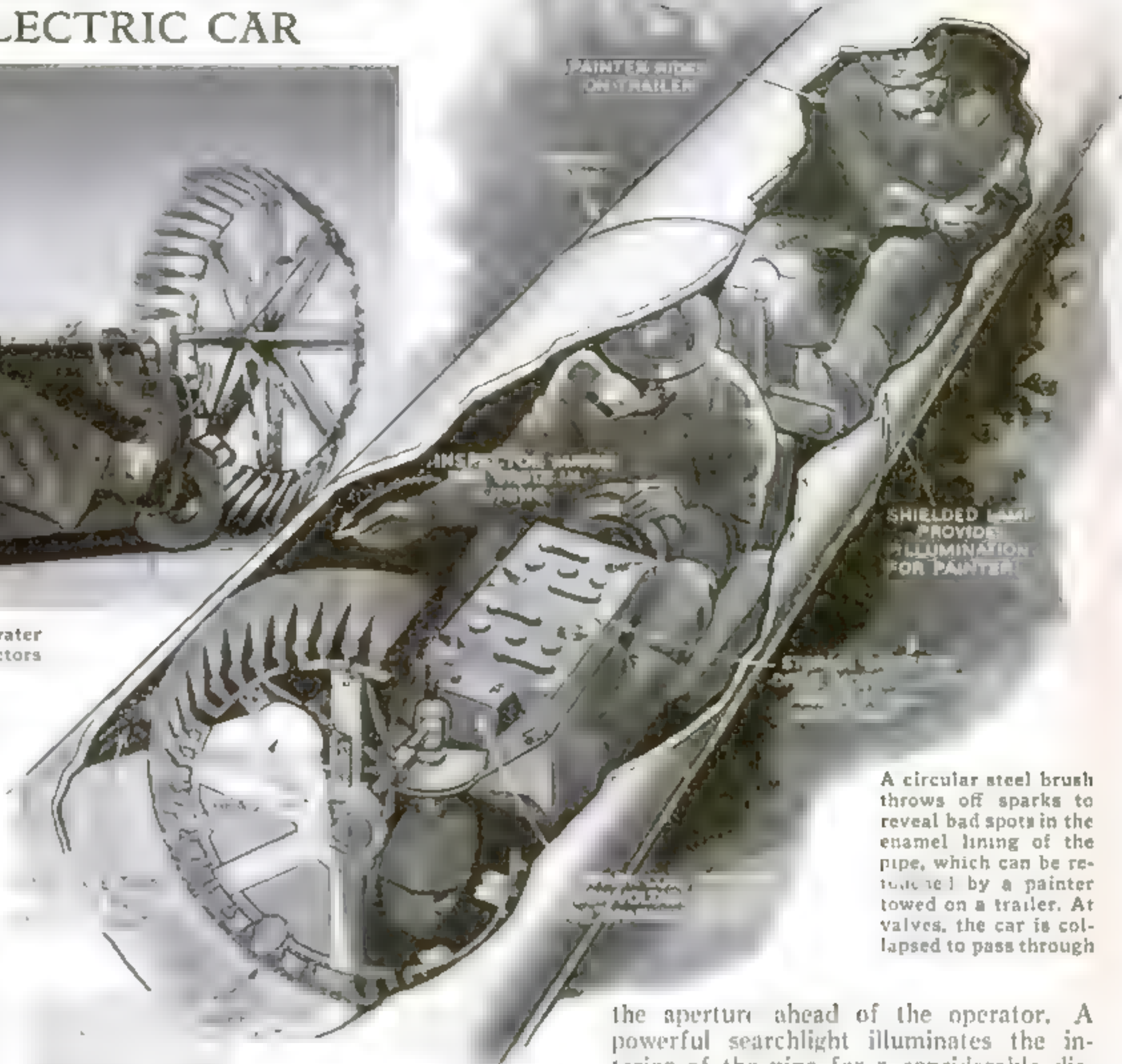
INSPECTOR TOURS WATER PIPE IN TINY ELECTRIC CAR



This three-wheeled electric car turns water pipes into subways for Los Angeles inspectors

KNOwn as a "pipe perambulator," a curious vehicle devised by a Los Angeles, Calif., draftsman turns the city's new thirty-six-inch water-supply pipes into miniature subways for inspection men before the aqueducts are placed in service. Storage batteries and an electric motor propel the three-wheeled vehicle along the interior of a metal conduit while the operator looks for defects. A circular steel brush at the front of the machine, charged with electricity, throws off sparks wherever the inner wall of the pipe lacks a proper protective coating of enamel. The spot may be marked for later attention, or a painter towed on a diminutive trailer may remedy the trouble at once.

When the pipe opening shrinks to twenty-inch diameter, at valves spaced along the water system, the "perambulator" may be partially collapsed and pushed through



A circular steel brush throws off sparks to reveal bad spots in the enamel lining of the pipe, which can be remedied by a painter towed on a trailer. At valves, the car is collapsed to pass through

the aperture ahead of the operator. A powerful searchlight illuminates the interior of the pipe for a considerable distance ahead, and a steering wheel enables the operator to guide the vehicle along the bottom of the pipe. In case one of the three pneumatic tires is punctured, the steering wheel can be used as a spare.



An ingenious camera that records readings on twenty-five phone-call registers at once, and a sample picture made with it

HUNTS RARE WORMS FOR TROPICAL FISH

COLLECTING worms that sell for two dollars a pound, as food for tropical fish, provides a profitable business for Morris Ernst of New York City. Public aquariums and private collectors are among his customers. No ordinary worms will do, but only the pinkish little "tubifex" variety that congregate in the oozy mud of sluggish streams and fresh-water marshes in New Jersey and Long Island. Wading to favored spots that he has located, Ernst scoops up dipperfuls of mud and strains out the moss-like batches of worms they contain.



Morris Ernst straining tubifex worms from the ooze of a marsh, for sale to tropical-fish owners. At the left is a batch of worms ready for serving

HUGE CAMERA READS METERS TO COUNT TELEPHONE CALLS

SPECIAL cameras of new design are taking the place of human meter readers who check and record, each month, the number of telephone calls for which you are to be billed. In the larger cities, a single telephone central office may employ as many as 10,000 individual registers or meters, and teams of clerks have been required to read them. Photographing twenty-five meters at a time, the cameras give a quicker reading and one that is proof against error.

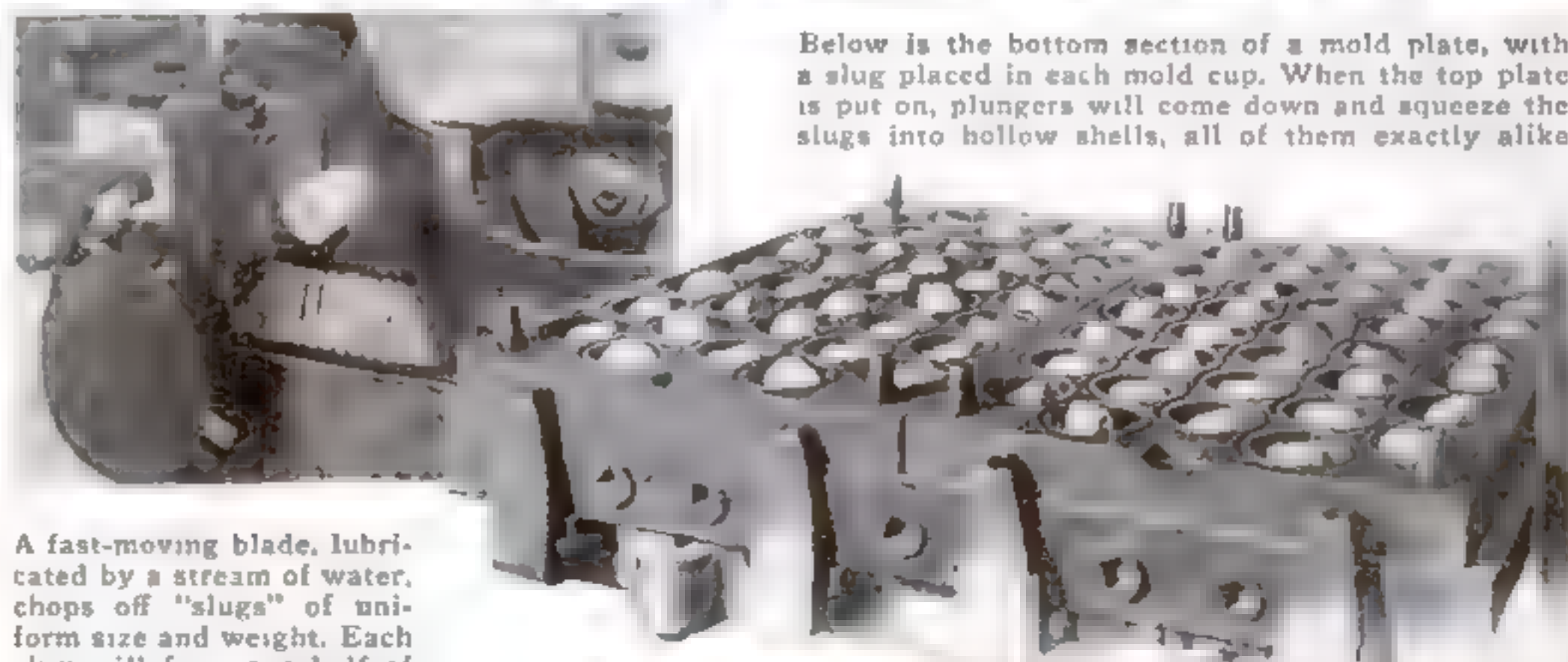


FROM RUBBER TREE to Tennis Balls



NEXT time you drive a well-placed tennis shot just out of reach of your opponent's racket, give some of the credit to the expert craftsmen who made the ball. How men and machines can turn out an endless stream of the white spheres, each an exact match for its predecessor in weight, balance, and liveliness, is shown in the unusual series of views reproduced on this page. Starting as a formless mass of doughy consistency, sap from the rubber tree passes through tubular and cup-shaped molds that gradually form it into the finished product. When the balls are smoothed and covered, they are as nearly uniform as human ingenuity can make them—and the rest depends upon the skill of the enthusiast who puts them in play.

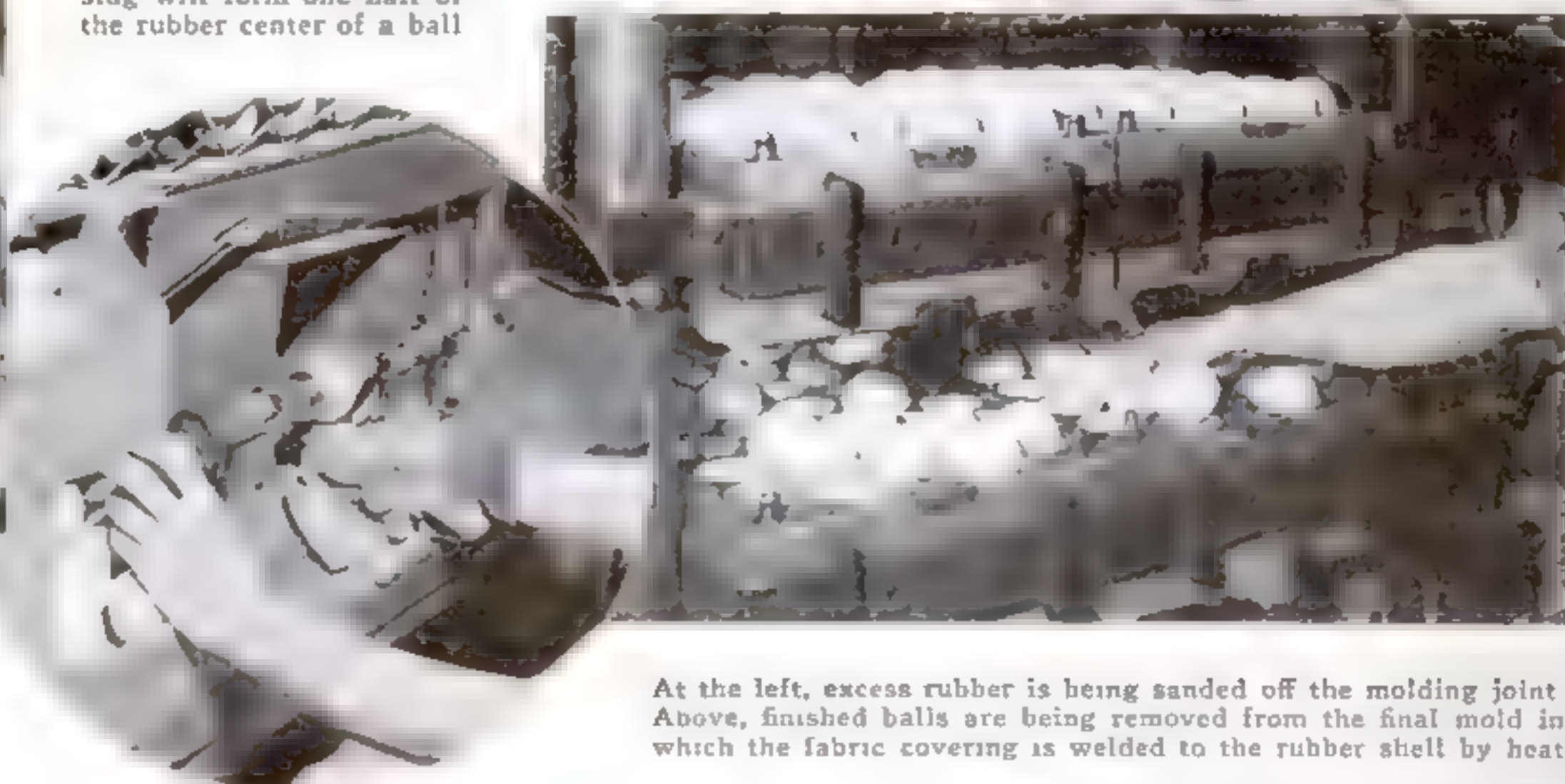
Coagulated sap of the rubber tree, imported from the East Indies, is mixed with other ingredients and milled between huge rollers. Then it is fed through the tubing machine, at right, which squirts it out in a long, cylindrical rope



Below is the bottom section of a mold plate, with a slug placed in each mold cup. When the top plate is put on, plungers will come down and squeeze the slugs into hollow shells, all of them exactly alike



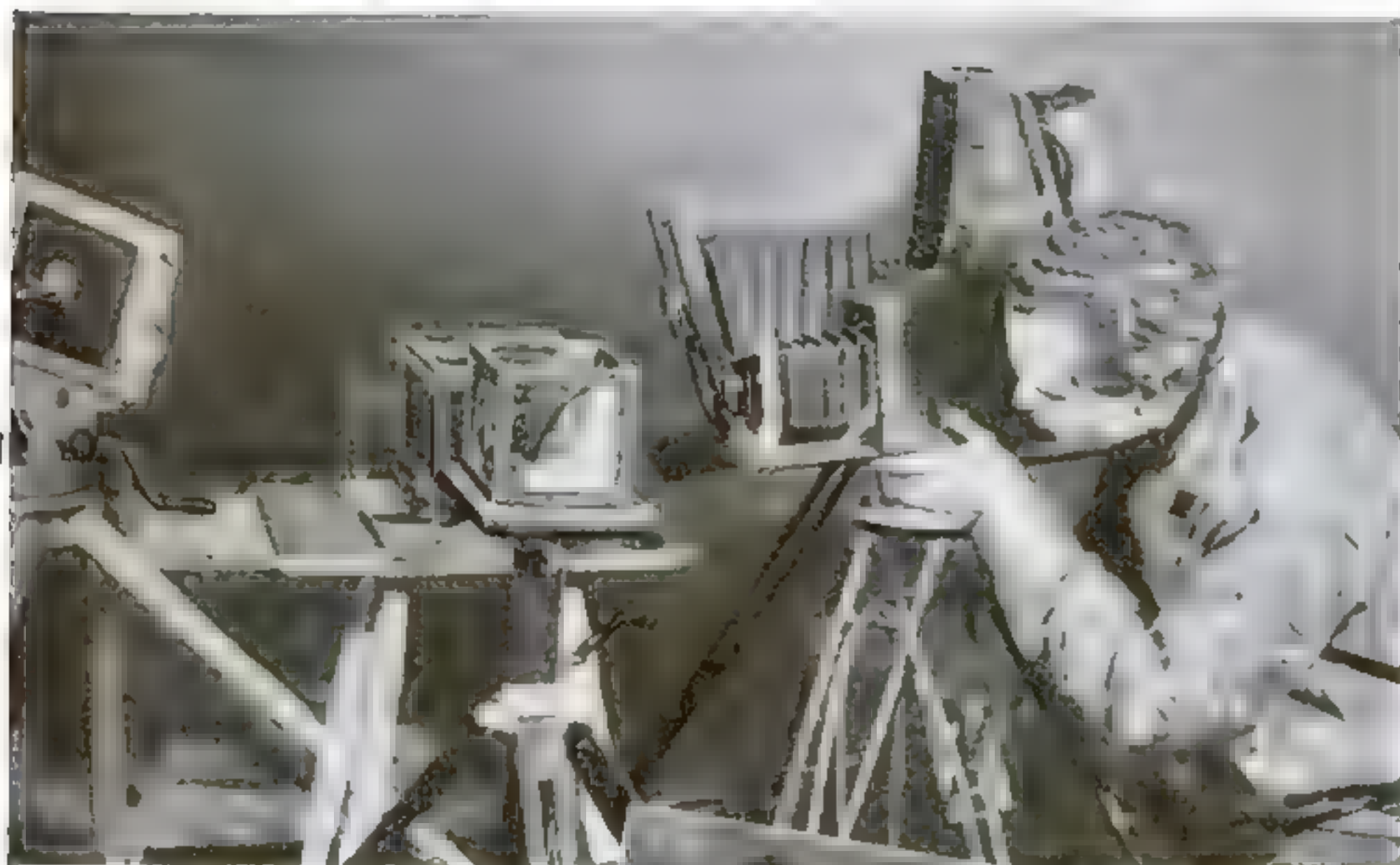
A fast-moving blade, lubricated by a stream of water, chops off "slugs" of uniform size and weight. Each slug will form one half of the rubber center of a ball



To trim off the "flash" around the molded shells, each is placed in a sharp-edged cup and a pair of rollers is revolved around the edge. The shells are now ready to be joined in pairs to form spheres

At the left, excess rubber is being sanded off the molding joint. Above, finished balls are being removed from the final mold in which the fabric covering is welded to the rubber shell by heat

TINY FISH "SIT" FOR ODD PORTRAITS



Lynwood M. Chace focusing a camera on a small fish in a studio aquarium

MAKING close-up "portrait" photographs of tiny fish and other forms of aquatic life is the unusual hobby of Lynwood M. Chace of Swansea, Mass. Clad in rubber boots and equipped with a net and pail, Chace scours the shallow waters of near-by ponds and marshes for interesting fresh-water specimens, which he deposits in a small glass-walled aquarium set up on a table in his photographic studio. After lights have been carefully arranged to obtain the best effect, the camera is placed with its lens a few inches from the side of the aquarium, as shown in the illustration above. When the fish swims into focus, the shutter is snapped, and Chace has obtained another striking "fish portrait." Sometimes he focuses three cameras on three aquariums at the same time, so as not to miss anything of interest.

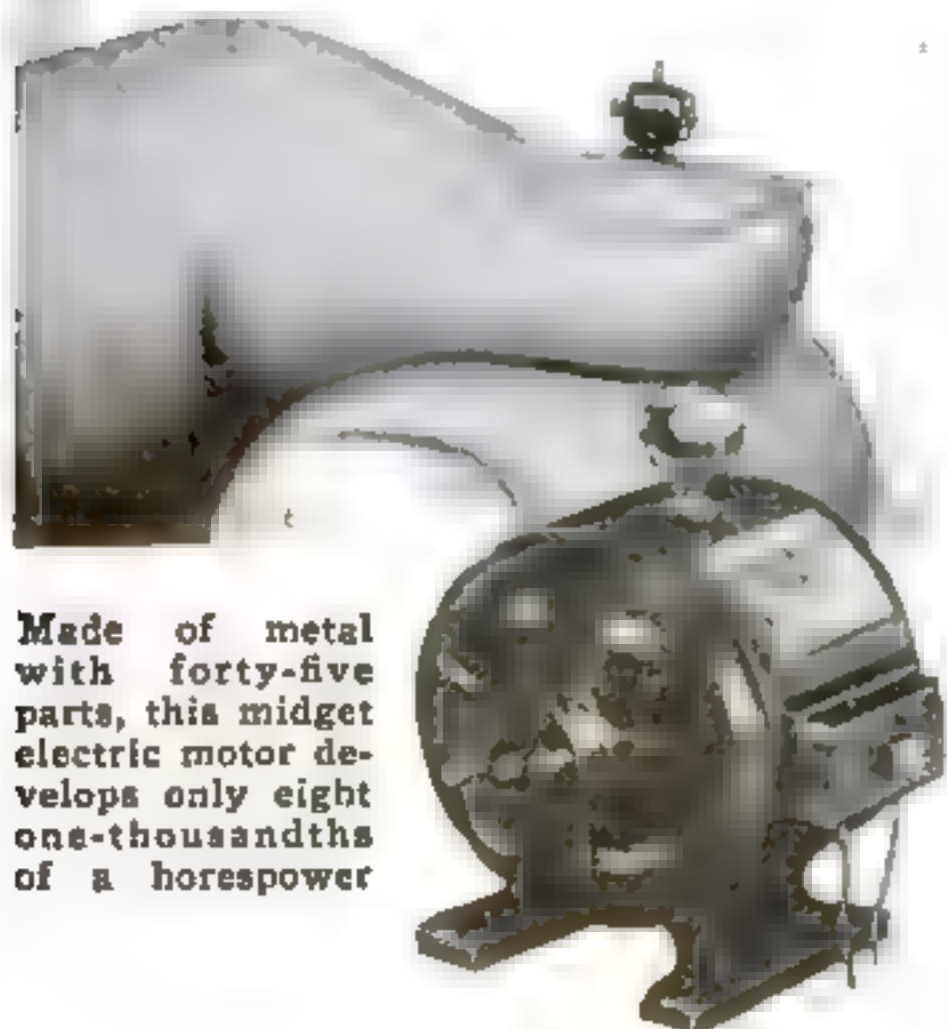


Portrait of one of Chace's subjects. Below, the photographer is seining a pond for new "sitters"



MODERN CRAFTSMEN COPY RARE INLAID FIDDLE

CONSISTING of more than 10,000 separate pieces, an elaborately inlaid example of the viola da gamba, a six-stringed ancestor of the modern violoncello, was exhibited recently in New York City. The rare musical instrument is a copy of one made by Joachim Tielbe, a German craftsman, in 1690 and now treasured in the National Museum at Munich.



Made of metal with forty-five parts, this midget electric motor develops only eight one-thousandths of a horsepower

FLY-SIZE MOTOR RUNS

So **TINY** that it rests easily on a finger nail, an electric motor constructed by an Italian youth weighs less than an ounce. The Lilliputian power plant has forty-five parts and develops about eight-one-thousandths of a horsepower.

TRACK FOR MODEL TRAIN IS FLEXIBLE IS FLEXIBLE

STRIPS of flexible track, just introduced for model-railroad use, can be twisted and turned in almost any direction to make loops, bridges, sharp curves, or steep grades. Made of small, interlocking rail segments held together with coiled wire, the metal track has realistic wood ties and can be rolled up for storage. The new O-gauge equipment, manufactured in four and six-foot sections, can be used with conventional model-railroad accessories.



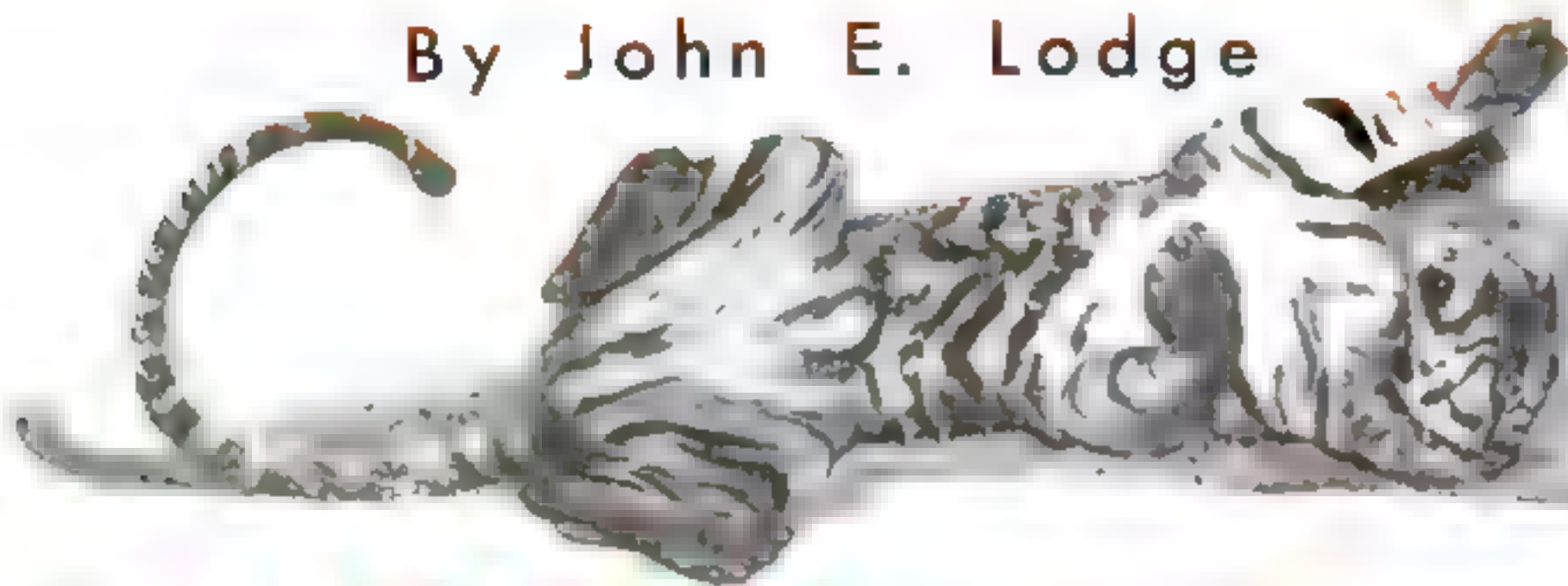
Model-railroad track made with jointed rail sections and wooden ties

Bert Nelson, animal trainer, putting a Bengal tiger through the difficult rolling act. At left, a group of circus performing lions



A DARING TRAINER MAKES JUNGLE ENEMIES PERFORM PEACEABLY TOGETHER IN THE ARENA

By John E. Lodge



When Lions and Tigers Mix in the Circus

NERO swung out of the chute leading into the cage, leaped nimbly onto the lower platform, and swung quickly to his place at the top of the pyramid. There the big, fine-maned African lion's head touched the rope net spread conelike across the duralumin-barred arena to prevent his leaping over and disappearing into the country.

"Nice fellow, Nero," murmured the trainer, touching the pedestal with his whip as a cue that the animal should remain seated. He raised his voice so it would carry through the canvas side wall to the nearby cages. "Let's have Sunny."

Nero's entrance had offered no difficulties, but now Bert Nelson was about to bring into the arena a Bengal tiger. Her entrance would mark the beginning of "mixing" the lion-and-tiger act which, a few weeks later, would move out from winter quarters at Baldwin Park, Calif., with the Al G. Barnes Circus.

Twelve lions and twelve tigers make up the most difficult and dangerous sort of jungle-cat act a skilled trainer can hope

to assemble. Within six weeks these animals, many of which now knew each other only as tenants of adjoining cages, not only would tolerate each other at claws' length, but also would sit on their high platforms in silence while individual stars charged, wrestled, accepted meat from their trainer's hand, and rolled over on command.

Soon I heard Sunny's heavy tread on the floor of the long chute as wooden bars clattered through openings to encourage her speedy entrance. To the accompaniment of a mighty roar from thirty-odd lions, tigers, hyenas, and leopards, Sunny slithered down the runway and raced clockwise around the arena to the pedestals. Nero regarded her silently, through eyes flashing with hatred.

"Nero!" the trainer shouted, brandishing a long buggy whip as he advanced upon the two scowling animals behind a barricade consisting of a worn chair and a long pole. "Don't do it! Steady, Nero! Up, Sunny! Up! Up!"

He flicked the tiger's hind quarters lightly with his whip. "Up, Sunny, quick!"



The tiger ascended the stairway of platforms until she reached the top-most, scarcely four feet distant from the lion. There, with a throaty gurgle, she sat, facing Nero. For a moment the two animals glared at each other, the lion swaying back and forth as though ready to spring upon his natural enemy. For no longer than a minute, Nelson stood below the two animals, cautioning them to remain steady. Then he backed quietly from the arena into the safety cage and ordered Sunny back to her cage. Urged by a stick in the hands of an assistant, she leaped to the ground and disappeared down the chute. Nero followed a few seconds later. Thus ended their first lesson in mutual tolerance.

The big mixed animal act doesn't "just happen." It begins with four lions which, from the beginning, take the seats assigned them for the season. Then come a tiger, with only one lion, for a brief introduction. Next, two tigers, one on each side of the lion. Now, three tigers alone, followed by three tigers with one lion. Some tigers and some lions



A new animal usually selects a favorite spot in the arena, and a pedestal is put there for him

simply will not mix with members of the other species. Each addition to the troupe is tentative, experimental, a laboratory trial. If the animal is so lacking in social virtues that it threatens to fly at the throat of another any moment, back it goes to the cage, there to await a chance to join some all-lion or all-tiger act.

"They're mortal enemies," Nelson assured me, after Nero and Sunny had retired, "and never become friendly unless they are raised together from cubs. Some come from the jungle, the majority from animal farms. Home-reared lions and tigers, while not tamed, are more tractable. I suppose that's because they depend upon humans for food from cubhood.

"With a mixed act, of course, I know there'll be trouble some day. There's no intelligence there to begin with, only instinct and hatred. When the trouble comes, I know the lions will whip the tigers—and me too, unless I get through that gate first."

For the better part of three days, I sat outside the arena under the circular tent observing the trainer as he put "green" cats through their paces, now mixing tigers with lions, again wheedling some potential star to perform a specialty number. One animal, I learned, may show ability to perform physical feats, while another may possess neither the intelligence nor the physical qualities necessary to do more than merely sit and growl.

The best performers join the circus when they are three or four years old. For a month or longer they sleep and eat in adjoining cages. No lion ever is introduced to a tiger for the first time in the arena, for a simple reason. "A lion

would jump a strange tiger without ceremony," Nelson explained. "And that might prove fatal to the tiger. For lions, you see, with great power and a fearless attack, easily whip tigers, which are 'back-fighters.' That is, they roll over and fight upward with their claws."

IN THE arena, the lions and tigers are first placed four feet apart, and gradually moved closer together, until at last they almost rub shoulders. This is usually accomplished by an assistant shoving the tiger from the side with a stick. If the tiger shows fight, the trainer drives him from the arena and calls for another.

Excepting Norma, a leaping lion whose 200 pounds hurtle through the air when Nelson signals her by body motions to land on his shoulders, all the lions and tigers are kept together. Norma was raised separately, and no one but the trainer feeds or pets her. She is a one-man lion.

Nelson started three years ago wrestling with Norma. She was two years old then, and he soon found that she would jump. When he crouched, as though to attack her, the lion would leap on him. To

make the trick appear more spontaneous, he gradually straightened up, and now she starts toward him whenever he lifts his arms above his
(Continued on page 104)



WHILE SPECTATORS GASP

Successive views of Norma, a trained lioness, leaping to the trainer's shoulders in a stunt that always thrills circus-goers



Here Nelson is giving his star performer a bit of meat as a reward for a specially brilliant trick

Amazing Cameras Built



Horace Rivero with some of the cameras he has built or rebuilt. The pictures at the right show his homemade miniature camera and the many parts that went into it

By WALTER E. BURTON

ONE DAY, four years ago, Horace Rivero jumped off the loading platform at the huge Union Terminal in Tampa, Fla. He had done that many times before, sometimes while carrying a heavy transit, for he had been construction engineer on the terminal project. On this particular jump, however, something snapped in his left leg; and, as a result, he spent most of the next four years in bed.

But, as another result, he has one of the most unusual collections of cameras and photographic equipment to be found anywhere in the world. It is truly unique, for he made every bit of it himself, mostly while propped up in bed, and largely with home-made hand tools.

To a man who has been active all his life, lying in bed all day becomes almost unbearable. Rivero grew tired of reading, sketching, and other diversions. And then photography came to his rescue and, so he believes, actually helped him to travel far on the way to complete recovery.

Rivero's masterpiece is a miniature camera that is equal in many respects to most miniatures on the market, and superior to many of them in some details. Rivero decided to become a miniature-camera fan after a friend visited him and showed him one of the latest European cameras using thirty-five-millimeter motion-picture film.

But a man who is unable to work at his profession would have difficult moments with his conscience if he spent \$100 or more for a midget camera. Rivero decided. So there was nothing left for him to do but to build the camera.

It's easy to make something when you have plans or a model to follow. But Rivero had



When Horace Rivero Was Laid Up by an Accident, He Turned to Photography as a Pastime—and Started from Scratch by Creating a Unique Collection of Homemade Cameras and Equipment

by Invalid as a Hobby

neither. True, he had examined his friend's camera for a few minutes; and he got hold of a drawing showing some of the general details of such a camera. But of the finer details he knew almost nothing. That did not discourage him. In fact, the necessity of doing his own pioneering was an asset in some ways, for it enabled him to do things that a professional camera designer might have considered impossible or undesirable. For instance, his miniature camera has a focusing range from nine inches to infinity, eliminating the necessity of using auxiliary lenses for taking pictures of insects, flowers, and other things which are to be shown almost life-size.

It is difficult to believe, from inspecting it, that Rivero's miniature camera has a family tree including discarded coffee percolators, old fountain pens, empty oil cans, odd bits of stainless steel, and parts from dismantled cameras of ancient make. But from such sources the builder got his material. Skillfully he transformed these things into an instrument with which he has made thousands of pictures, ranging from landscapes to photomicrographs.

The camera itself is about the size of familiar miniature cameras which make pictures measuring one by one and a half

inches or smaller. It has a removable back, a film magazine for daylight loading, an accurate view finder, rewind mechanism for reeling the film strip back into the magazine after exposure, and an automatic device that makes double exposures impossible. There is a calibrated shutter-speed knob, and a graduated disk that indicates the number of exposures that have been made. The camera uses either perforated or unperforated film.

But the most remarkable detail of all is the focal-plane shutter. Rivero says that it is simpler and more rugged than similar types used in commercial cameras he has examined since building his. It is of the adjustable-slit type, and is made of special shutter cloth he obtained from a camera manufacturer. The springs, gears, and other necessary shutter parts he made himself. The shutter speed is from 1/20 to 1/300 second, ample for practically all work with the short-focus lens he uses.

This lens was the starting point of the camera. When he decided to tackle the job, he got hold of a 1 3/4-inch focus lens with a speed rating of F/3.2. It forms in the camera a sharp image of about the same size as a standard motion-picture frame—three-quarters by one inch. Since building the camera, Rivero has added other lenses, including a long-focus one for telephoto work. The lenses are focused by scale, but the builder plans to add a coupled range finder some day.

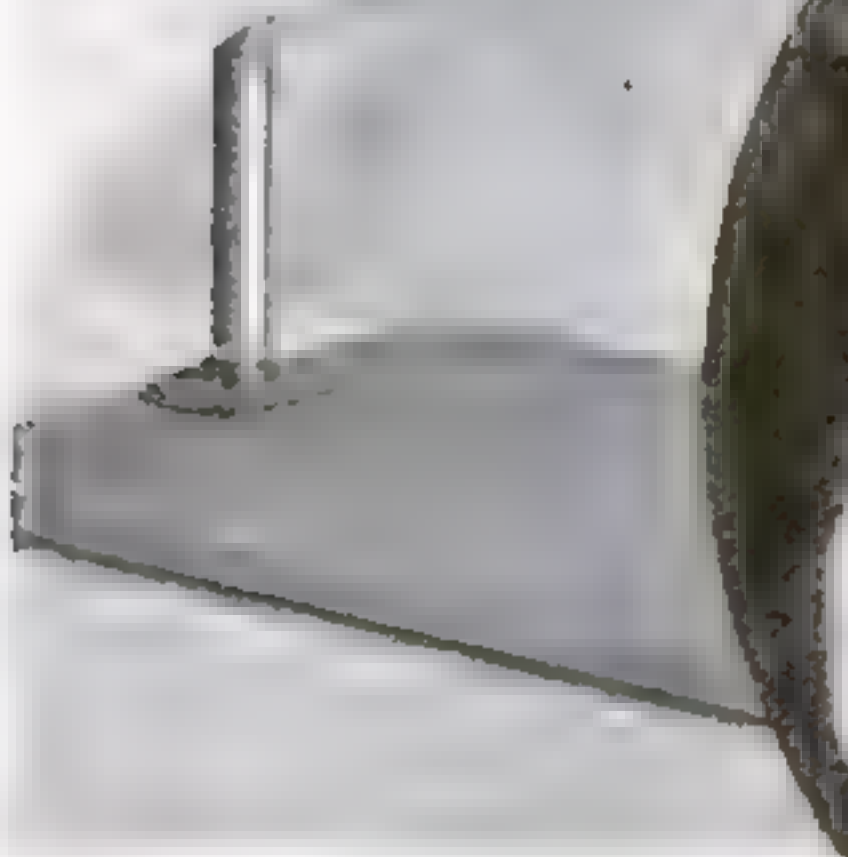
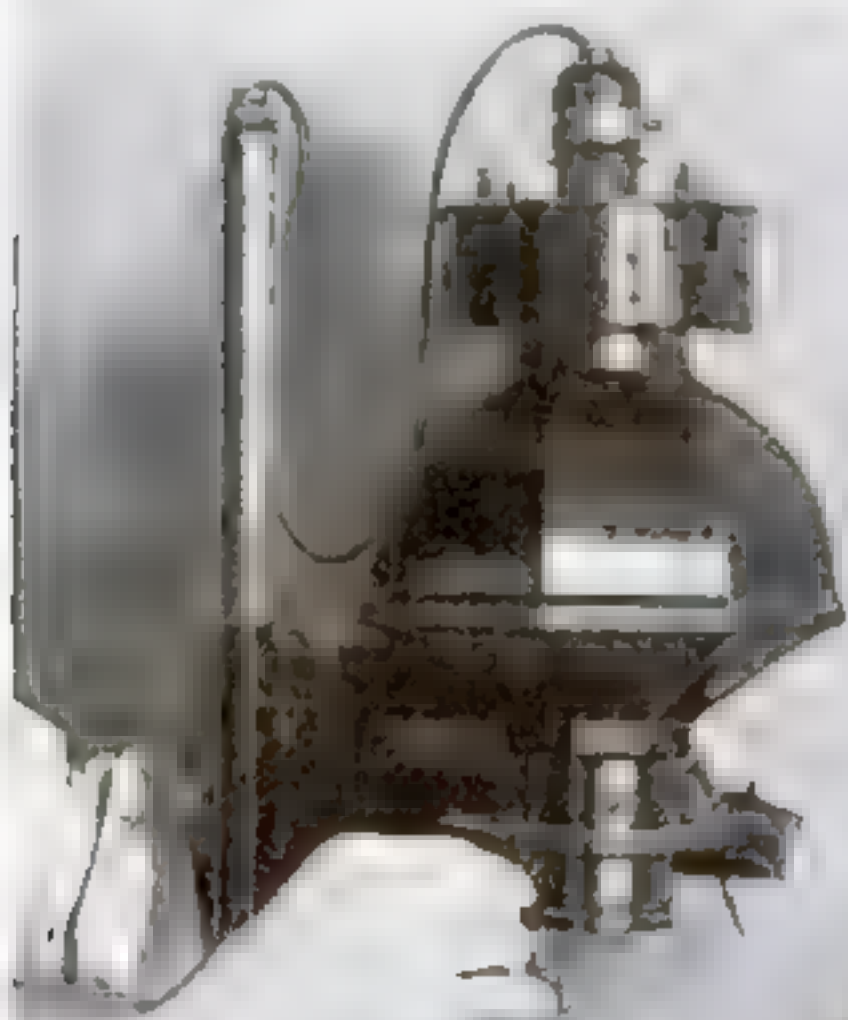
The camera is the more marvelous when you consider that it is almost 100-percent handmade. Outside of the lens, there are only two pieces that Rivero did not fashion while in bed, with the aid of a large drawing board, a vise clamped to the board, and an assortment of hand tools. He did, however, hobble around on

crutches in order to do some soldering in the kitchen.

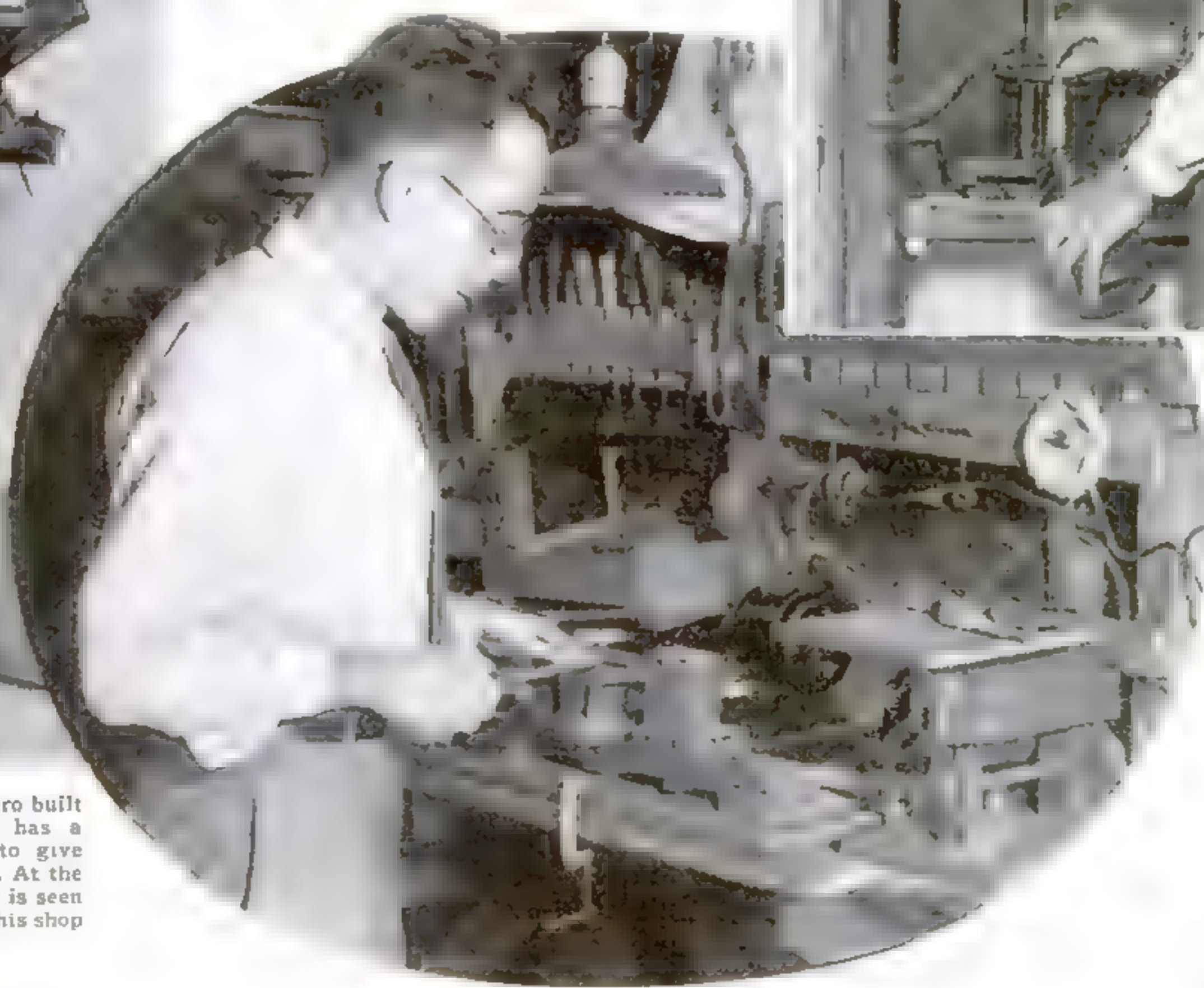
Rivero believes that some of his success with the finer details of construction is due to his being near-sighted; he can see things at close range better than most people. This belief is supported by some of the work in the camera. There is, for instance, a ratchet gear measuring a half inch across and having thirty-two teeth. He cut it entirely by hand, with the aid of a file and an accurate eye, while lying in bed!

The miniature camera naturally created a need for an *(Continued on page 108)*

Rivero draining solution from the developing tank in the tiny darkroom located in his garage



When he needed an enlarger, Rivero built himself this efficient outfit. It has a reflector scientifically designed to give even illumination on the negative. At the right, the amateur camera builder is seen working at the homemade lathe in his shop



Right, floating balls representing the sun and planets. Below, a working miniature air line



MODEL PLANES RIDE JETS OF AIR

TINY air jets mounted under a map of the United States operate an ingenious model of a transcontinental air line built by a California inventor. Featherweight planes, supported by the vertical air currents, float across the map in realistic fashion. The airplanes can be made to hover

steadily over any one "city" at will. Another application of the idea, shown in the top photograph, is a working model of the solar system in which lightweight balls, held up by moving jets of air, rotate around a central sun to represent the movements of the planets.

HANDY FINGERPRINT CHART AIDS AMATEUR SLEUTHS

STUDENTS of criminology may be aided by a handy fingerprint practice chart just invented. Vertical strips bearing sample prints slide under a mask that has apertures placed in the manner of a standard police fingerprint card. More than 600,000 different classifications can be illustrated for study.

Sliding strips display fingerprints of many types in slots on the mask, which resembles the cards used in official police files



Painted disks revolve under a rubber wheel to gauge the wearing qualities of pigments



MACHINE TESTS PAINT FOR TRAFFIC LANES

PAINT used to mark traffic lanes and safety zones on streets and highways is tested for wearing quality by a new apparatus, pictured above, in use at the U. S. Bureau of Standards, Washington, D. C. Disks covered with various types of paint revolve under a chain-driven rubber wheel that simulates the rubbing action of an automobile tire.

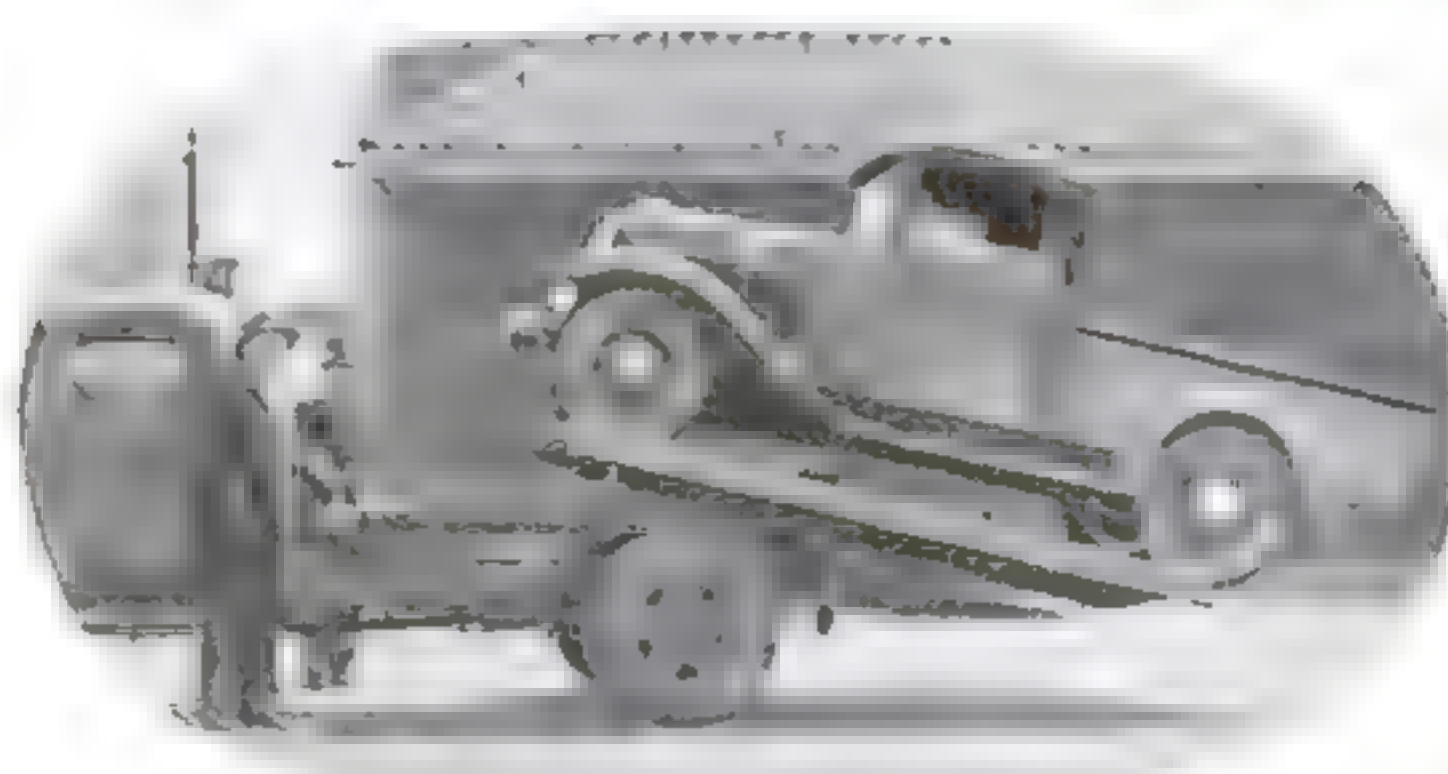
STETHOSCOPE FINDS FLAWS IN CLOCKS

ELECTRIC clocks manufactured at a large Massachusetts factory are checked before shipment with the aid of a stethoscope of the type used by physicians for listening to sounds within the human body. When clocks are completed, a technician listens to their "heartbeats" to detect any abnormal internal noise that would indicate faulty parts or assembly. The photograph at the right shows a group of clocks being put to the test.



An expert listening to the "heartbeats" of new electric clocks with a stethoscope to detect abnormal noises that indicate faulty construction

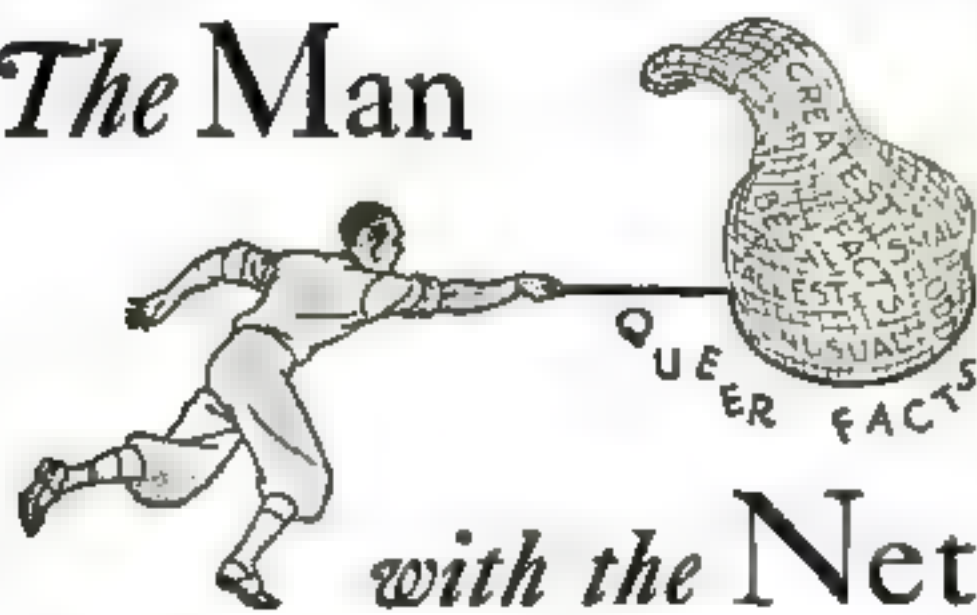
TRUCK BED SLIDES OFF FOR LOADING



A car being loaded on a truck by means of the novel sliding bed

LOADING and unloading are facilitated by the new truck bed shown at the left. Sliding back along the chassis, the bed is lowered to the ground by means of a winch to receive its load. The manufacturers claim that the device cuts loading time as much as ninety percent and allows one man to handle heavy shipments. It can be transferred from old trucks to new.

The Man



with the Net

SYNTHETIC LINEN is being produced from milk in an Italian textile factory.

WATERMELONS that weigh more than 100 pounds are raised along the Tigris River in Turkey.

GERMAN CHILDREN have to get permission from the Air Ministry to fly kites more than 300 feet above the ground.



AMERICAN TYPISTS, it is estimated, use up 130,000,000 typewriter ribbons a month.

BOYS have toothache more often than girls.

EELS are used by a plumber in Denmark to clean out clogged pipes.



SAWS are made with more than twenty-four different kinds of teeth.

INYO COUNTY, in California, contains both the highest and the lowest spots in the United States.

GRIZZLY BEARS can run thirty miles an hour.



BABIES have eleven more bones than adults. In later life, some of the small bones of the spine and skull join, thus reducing the total number in the adult skeleton.

AUTOMOBILE-ENGINE lubricants in Tunis, Algeria, are required by law to contain at least twenty-five percent olive oil.

ASTRONOMICAL NEGATIVES in the collection at Harvard University number 400,000 and weigh nearly 100 tons.

CHEWING gum was relished by stone-age men.



WINE BOTTLES TEST OCEAN CURRENTS

TIGHTLY corked, 6,000 wine bottles were cast adrift recently in the ocean off southern California to check the drift of offshore currents. Each bottle contained a post card requesting the finder to report the location of his discovery to the State Fisheries Laboratory. The novel system was adopted to aid in determining the movements of sardine eggs, larvae, and young fish, which are known to drift along in surface currents.



Fisheries expert throwing bottles into the sea to check current drift

NOVEL TIMEPIECE IS TWO-FACED

VISIBLE through holes in its face, two sets of numerals appear alternately on the dial of a new clock. At noon, a disk behind the clock face automatically shifts so that the numerals from one to twelve are replaced by those from thirteen to twenty-four, to conform to the European system of time recording.

Clocks with automatic dials for telling time by the European twenty-four-hour system



MICROPHONE LOOKS LIKE SALTCELLAR

RESEMBLING a table salt shaker, a new midget microphone for radio use combines the features of both universal and directional types. When a small baffle is added, the unit concentrates on sounds from one direction.

DIVER LOCATES GOOD FISHING PLACES

To DISCOVER the favorite haunts of fish in a Massachusetts lake, a group of anglers recently adopted the novel method of employing a diver to scout the lake

bottom. Wearing full deep-sea equipment, the diver made frequent telephone reports to sportsmen on the shore from his underwater vantage point.



From the lake bottom, this diver will report on fishing conditions by telephone to anglers

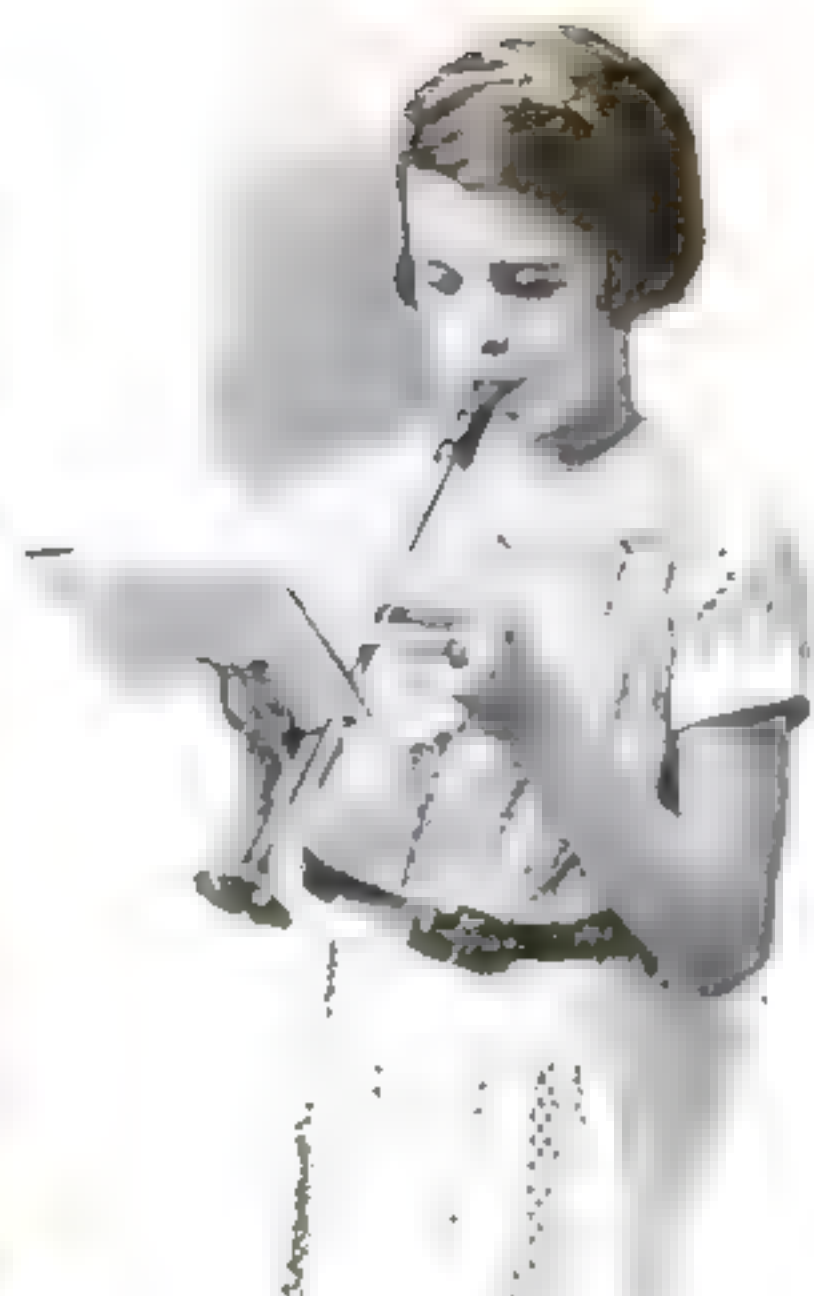
AMATEURS GRIND TELESCOPE MIRRORS



AMATEUR astronomers are learning how to grind telescope mirrors in a novel training class jointly sponsored by New York University and the Hayden Planetarium of New York City. The group works at "desks" made of old oil drums, filled with water to make them steady and provided with wooden tops to which are clamped the necessary tools. Starting with simple rough grinding, the students gradually work up to more delicate polishing. Each member of the group is making a six-inch mirror that will be accurate to within four one-millionths of an inch.

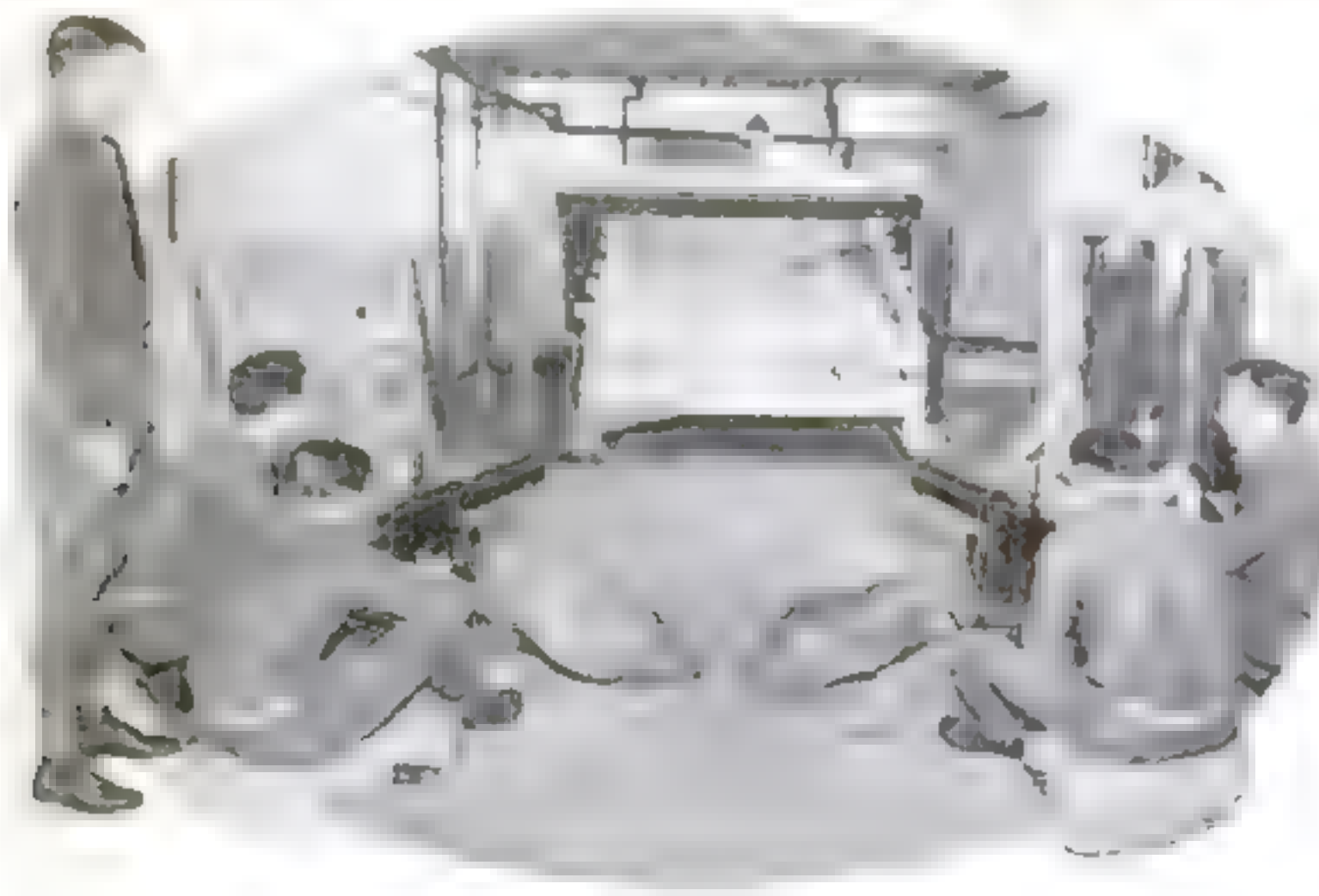


The mirror-grinding class in session. The smaller picture shows the under disk used in polishing



END-BLOWN FLUTE AIDS MUSIC STUDY

A MODERN end-blown flute, similar to types in use over 300 years ago, has been introduced as a practice instrument for children learning to read music. The flute covers a two-octave range and has a special mouthpiece said to produce a good tone at all times.



SAND TARGET APES BATTLEFIELD

Using a sand target made to resemble the battle lines of an imaginary foe, an unusual indoor shooting range is being used for machine-gun practice by soldiers of the Sixth U.S. Infantry, stationed at Jefferson Barracks, St. Louis, Mo. Marked off into sectors as shown in the photograph above, the target slopes up gradually from front to back to create an illusion of depth.

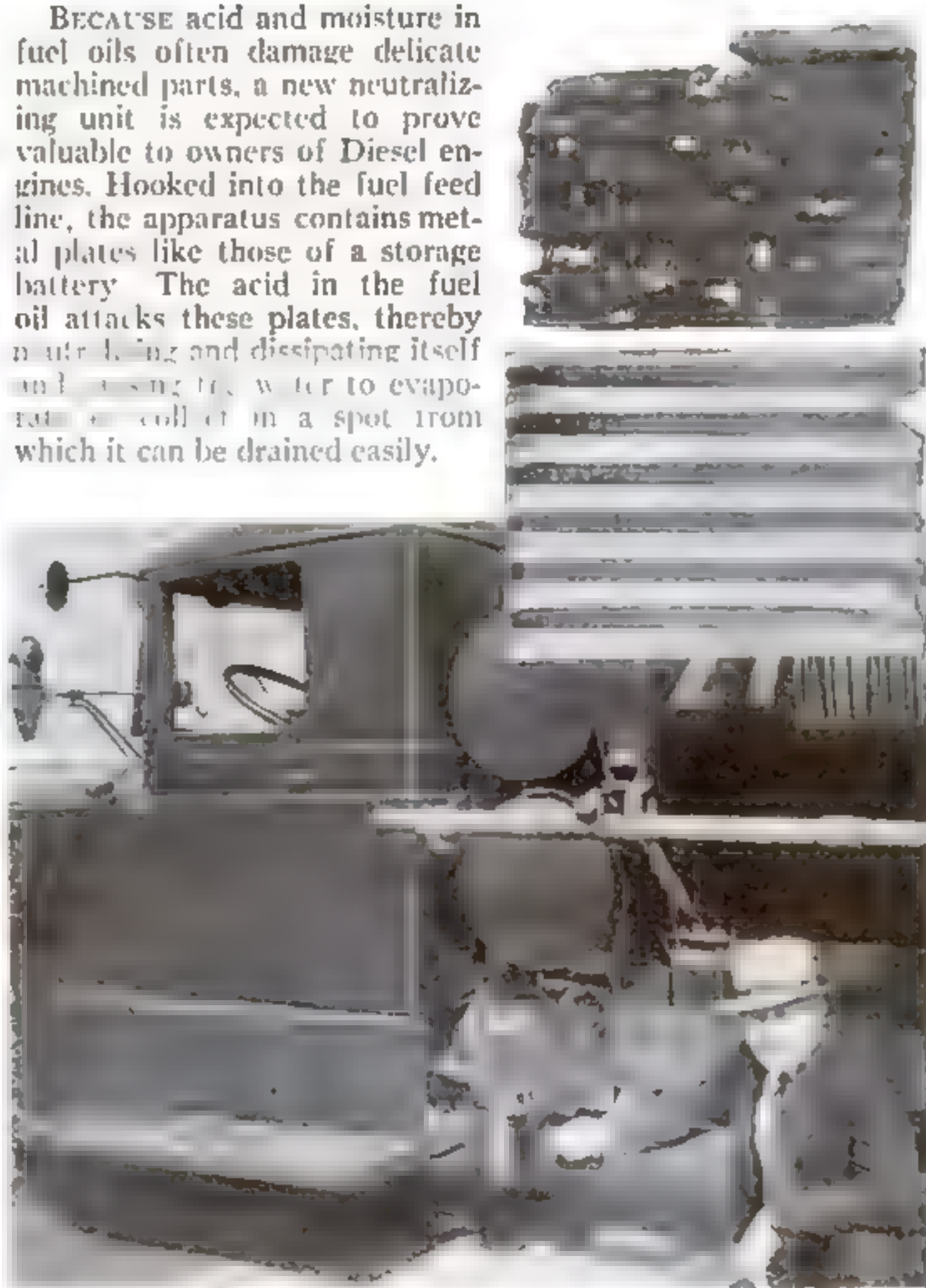
WASHING MACHINE FOR TRAILERS



REQUIRING exceptionally little space for storing, a new hand-operated washing machine is designed for trailer use. The washer is equipped with a detachable wringer that can be stored within the tub when not in use. When the mechanical washing unit is removed, the machine will serve as an infant's bathtub.

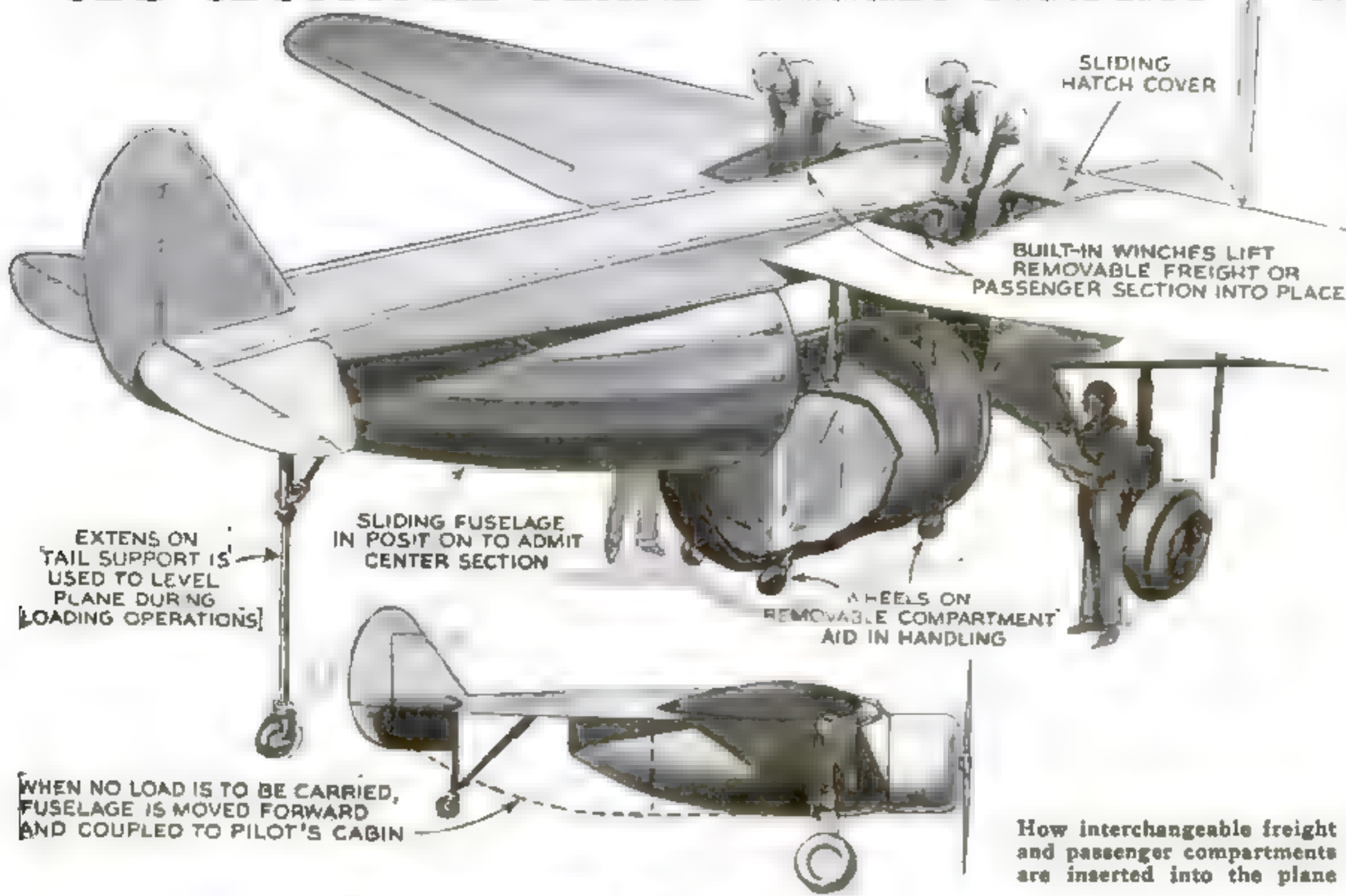
FUEL PURIFIER FOR DIESEL ENGINES

BECAUSE acid and moisture in fuel oils often damage delicate machined parts, a new neutralizing unit is expected to prove valuable to owners of Diesel engines. Hooked into the fuel feed line, the apparatus contains metal plates like those of a storage battery. The acid in the fuel oil attacks these plates, thereby neutralizing and dissipating itself and causing the water to evaporate or collect in a spot from which it can be drained easily.



Oil-neutralizing unit installed in a truck. The inset contrasts a new plate with one that has been eaten away by acid contained in the fuel

ODD SECTIONAL PLANE CARRIES FREIGHT OR PASSENGERS

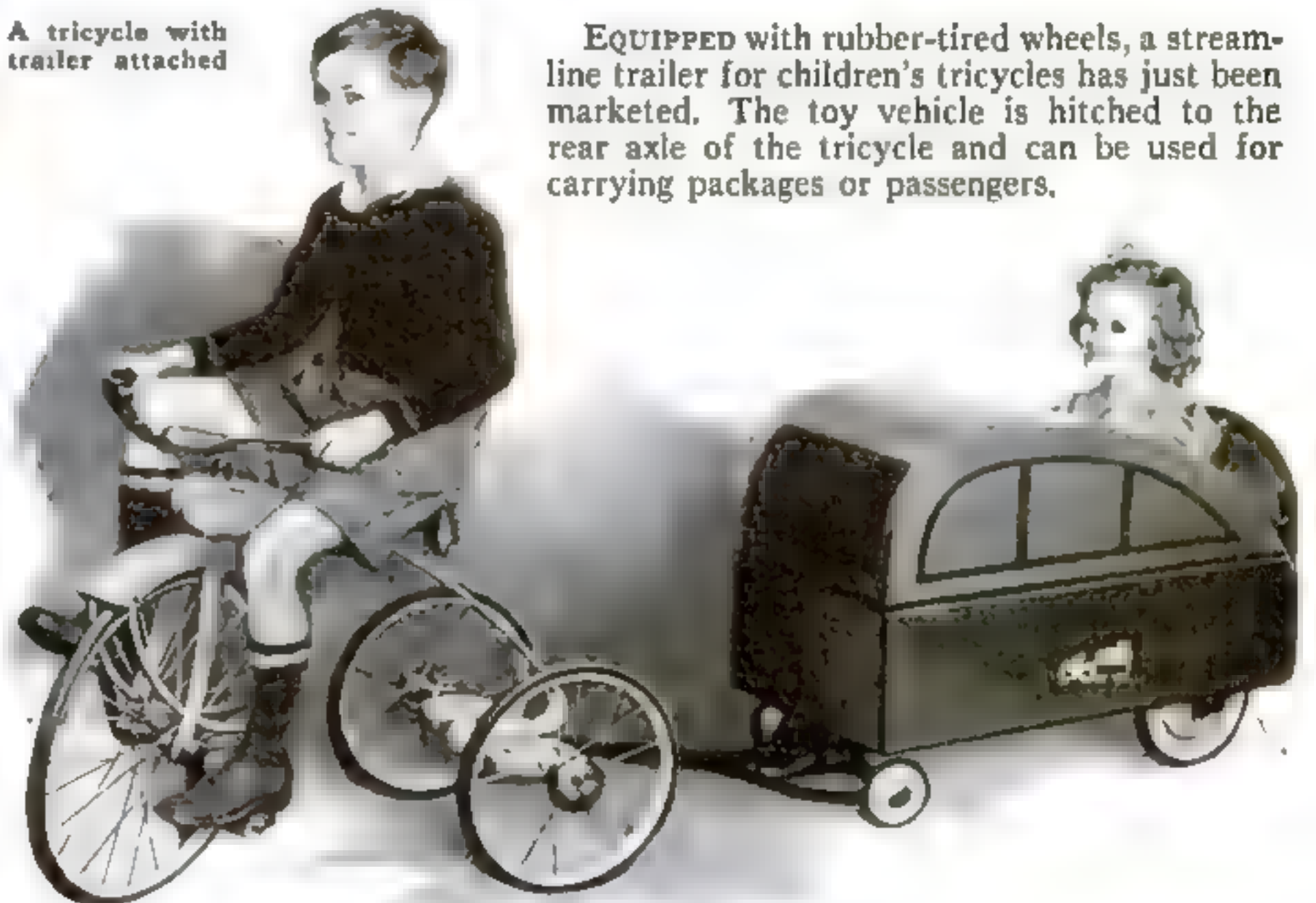


ADAPTABLE to either freight or passenger transportation, a plane of new design incorporates a removable central compartment. When used for freight, a completely loaded section, constructed to fit into the streamline shape of the fuselage, can be hoisted into place between the pilot's cabin and the tail by means of hand-operated winches set into the wing structure. For passenger service, the freight compartment is replaced by a passenger cabin fitted with seats and windows. If neither freight nor passengers are to be carried, the rear of the fuselage can be moved forward to join the pilot's cabin. An extension tail support is used to hold the plane level during loading or unloading operations, and covers hide the winches in flight.

TRICYCLE PULLS STREAMLINE TRAILER

A tricycle with trailer attached

EQUIPPED with rubber-tired wheels, a streamline trailer for children's tricycles has just been marketed. The toy vehicle is hitched to the rear axle of the tricycle and can be used for carrying packages or passengers.



TOOTHBRUSH IS U-SHAPED

BRISTLES line the inner curve of a novel U-shaped toothbrush now available. When placed so that the teeth fit into the U, the brush cleans both sides of the teeth at the same time. The brush is said to be a timesaver as well as an efficient cleaner.



CORN KNIFE IS WORN ON USER'S LEG

STRAPPED to one leg, a new corn-stalk cutter slices off the stems as the user walks along a row. The "ankle blade" leaves the hands free for grasping and holding the cut stalks.

TRUCK DESTROYS WEEDS WITH BLOWTORCHES

LONG-HANDLED blowtorches attached to a moving truck are now used to destroy weed growth and thus prevent the clogging of irrigation ditches in Arizona. As one man drives the truck, helpers direct the flames into the ditches. A small gasoline engine on the truck body supplies pressure for the burners.



Truck with blowtorches used for burning weeds to keep irrigation ditches from clogging

HOW EXPERT GLASS BLOWERS MAKE Artificial Eyes



1 The first step in the manufacture of an artificial eye is to heat a tube of special imported glass and draw the end away. The detached piece will form the "sclera," or base, of the new eye



2 Here the globule of glass has been pulled away, and still is clinging by a thread to the main tube. Note the special Bunsen burner

3 At the right, the hollow section of tubing is being blown into a round bubble, which is the original shape of an artificial eye



4 The delicate colors are imparted by means of rods of colored glass, heated intensely



5 A thin film of color is left on the eye. In this case, the eyeball is receiving a tint



6 To simulate veins, gossamer threads of colored glass are spun onto the eyeball



7 Intense heat from a fine, white flame smooths and rounds off the tinted eye

U SING about 100 pounds of special glass imported each year from the little town of Lauscha, Germany, fifteen American experts fashion all the artificial eyes made to order in the United States. This annual total is close to 20,000. The photographs on these pages show the delicate operations by which these specialists imitate nature's handiwork.

Since 1851, when Pierre Gougelman produced the first artificial eye made in America, the outstanding advance has been the introduction of the Snellen-type eye. In place of a simple concave shell, it has a back and the space between contains a vacuum. Because it is more comfortable and provides better movement, it now outsells the older models, three to one. The price of the latest artificial eye runs from fifteen to fifty dollars.

Usually, artificial eyes are made slightly smaller than the corresponding real ones in order to render them less conspicuous. In many cases, patrons order two eyes at once, one for day wear, the other for use at night. The latter has a larger pupil. The latest innovation in the field is the "hangover eye," a bloodshot creation designed to match the real eye on "the morning after the night before."

The life of an artificial eye depends largely upon the acid condition of the user's body. As soon as the glass becomes roughened, so that it irritates the sensitive membranes, it must be replaced. This usually occurs in about a year or a year and a half. Athletes engaging in such

This cabinet contains a large assortment of ready-made artificial eyes, classified according to their size, type, shape, color, and general construction



*In These Pictures, You Can Watch
A Skillful Artist at His Task of
Shaping Delicate Bubbles of Glass
Into Likenesses of Nature's Handiwork*



8 Every few minutes, as the delicate operation of shaping the eye progresses, it is carefully compared with a finished eye

rough sports as boxing and wrestling have sometimes worn glass eyes, and one star football player on a southern eleven went through several seasons without damaging his artificial eye. The leading manufacturer in the country reports that out of 200,000 eyes sold, only one was reported broken through being struck. Hot towels used in barber shops are declared to be responsible for most cracked glass eyes.

In fitting a patient, his age, race, and the expression of his face are all taken into consideration. Children, for example, have fewer veins in the whites of their eyes than old people. The ages of the users range from six months to ninety-two years. Orientals have eyeballs with a yellowish tinge. Those of a negro, contrary to general opinion, are much darker than those of a white person.

In several instances, patients who have lost both eyes have been fitted with glass ones for the sake of comfort and appearance. One such patient, a young man, came back to have his eyes changed from blue to brown. His best girl had a preference for brown-eyed men.

Surgeons, during recent years, have developed a technique for implanting small glass or gold balls in the eye sockets so that the muscles adhere to them, thus providing bases upon which the artificial eyes can turn naturally in unison with the good ones.

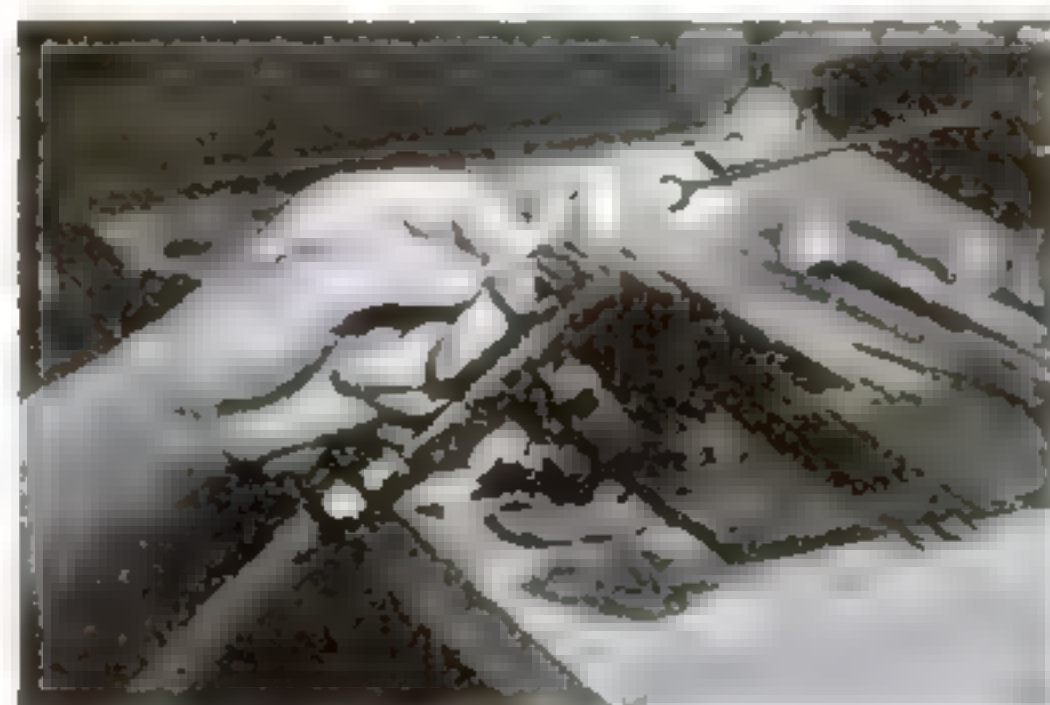
Animals, as well as human beings, are sometimes equipped with artificial eyes. A New York banker recently ordered a glass eye for a prized polo pony. At other times, bulldogs, cats, and parrots have had special eyes made for them. One order, however, was turned down, a couple of years ago. A zoo owner wanted some one to come up and install an artificial eye in a Bengal tiger!



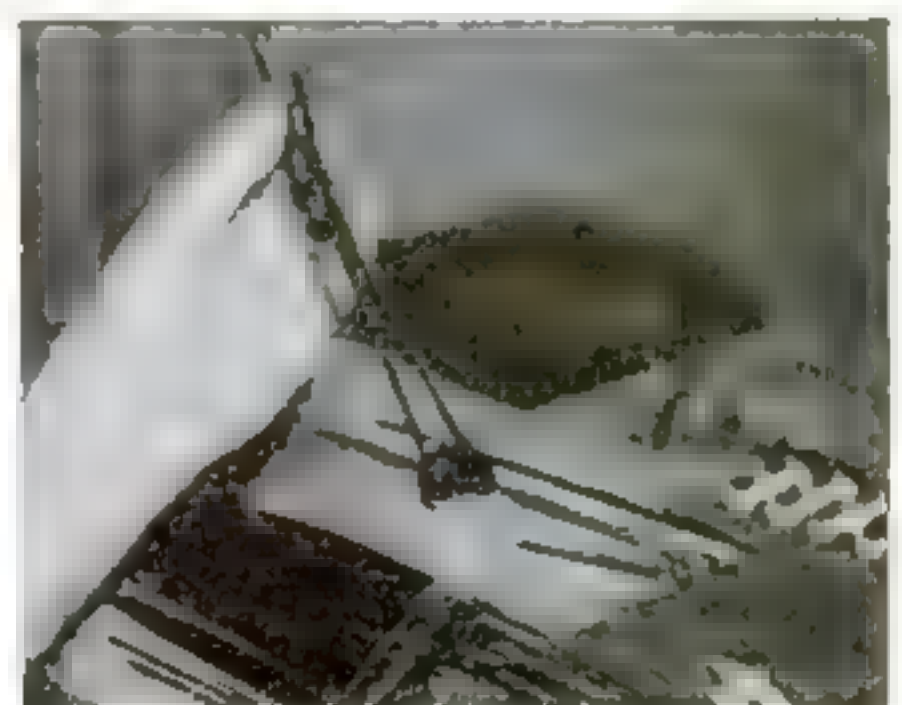
9 Now the eye is ready for the final shaping process. Notice the long forceps used to hold it



10 The featherweight glass shell is heated and gently molded into form



11 After the eye is completely shaped, the stem is withdrawn and the back of the eye sealed



12 A carbon flame anneals the glass. When cleaned, the eye is completed



Glass eyes and the gold balls used to control eyeball movements. A user can even keep an extra "bloodshot" eye to match the natural one on "the morning after the night before"



MASK AND CAMERA FIT FALSE TEETH

A NOVEL dental technique just introduced is said to insure natural-looking false teeth. Before decayed teeth are extracted, the patient's face is photographed with a movie camera and a mask is made

with moulage, a casting material. The developed film and the cast guide the dentist in making a set of teeth that will not alter the lines of the face.

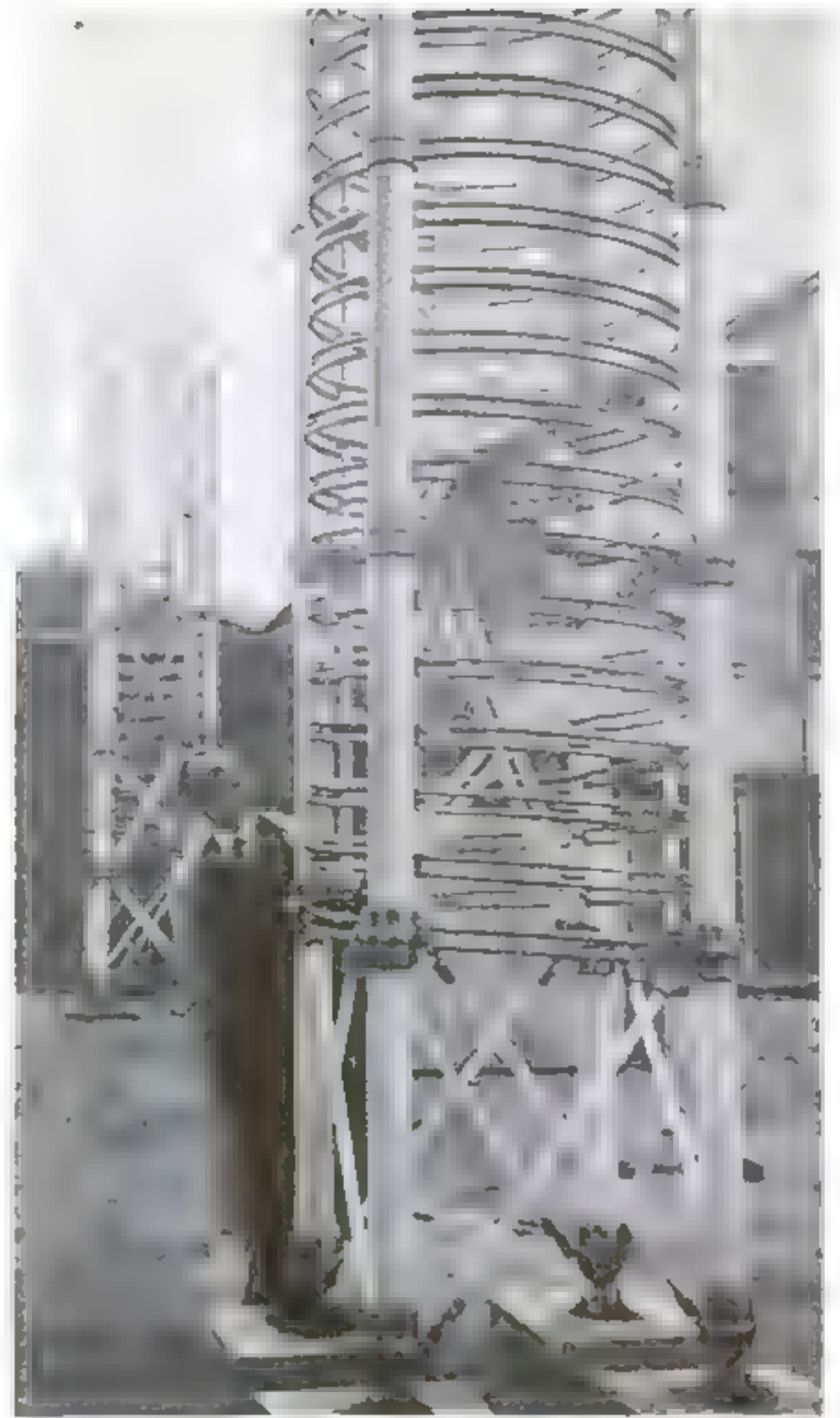
NEW GOLF BALLS LOOK LARGER

TO AID the average golfer to better his score, a new golf ball has a cover marked with a rough triangular pattern. According to the makers, the cover pattern creates the illusion of a larger ball, thus adding to the confidence of the golfer who is about to make his swing. The marking is available on balls of various types and grades.



New-style golf balls with triangle cover pattern

TWENTY-THREE-FOOT SPARKS THRILL PARIS FAIR CROWDS



Tower coils used to create the high-frequency spark

LEAPING across a gap of almost twenty-three feet, a mammoth high-frequency spark provides an interesting sight for visitors to the Palace of Electricity at the International Exposition in Paris, France. Novel tower coils, shown in the photograph above, are used to create the giant electric arc, said to be the longest spark ever produced without the aid of charged condensers.

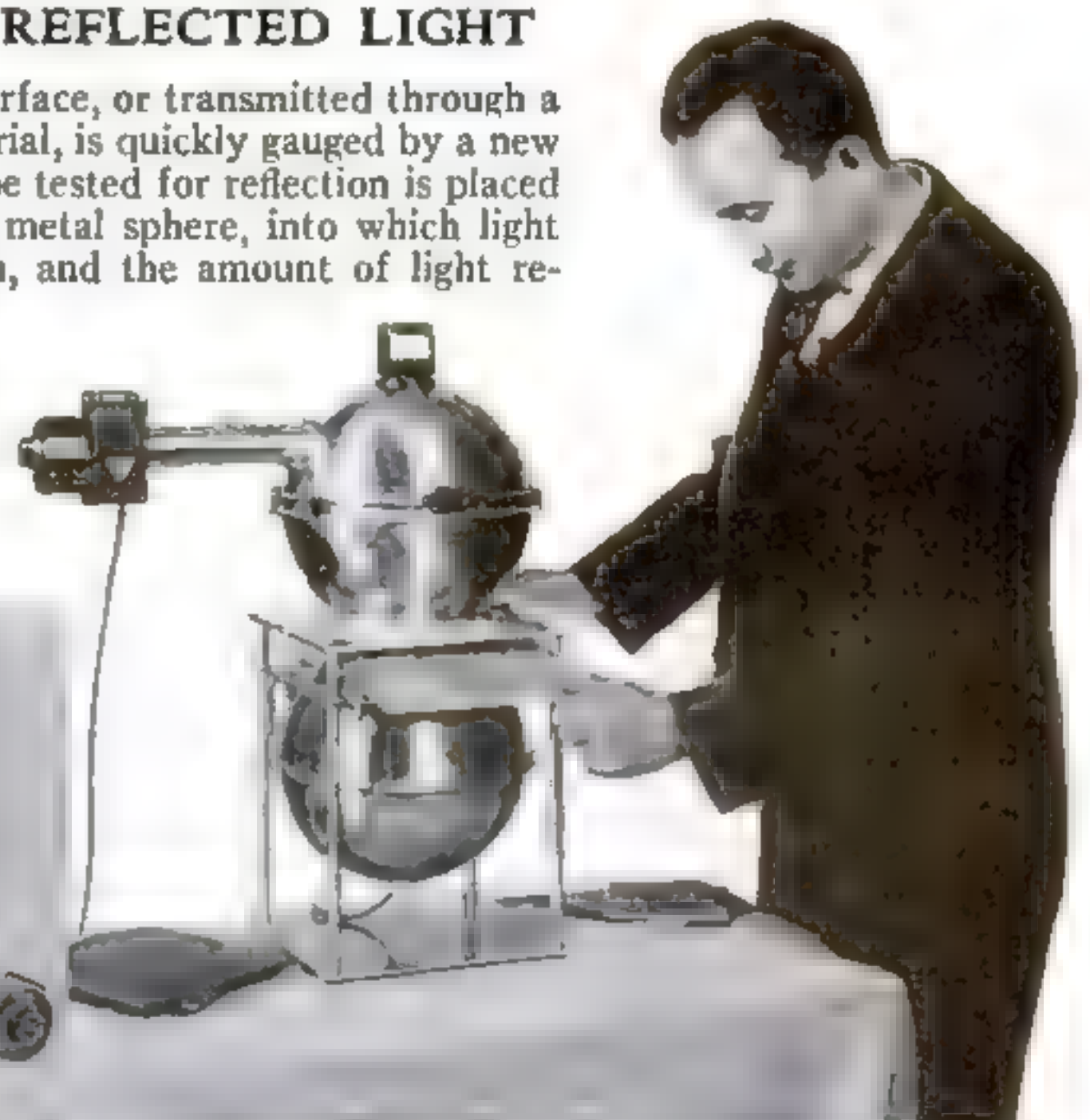


ELECTRIC METER GAUGES THICKNESS OF PAINT

PAINT thickness on steel can now be measured accurately without digging into or marring the paint. A new device indicates the thickness of the paint by a dial that records its electrical resistance. The apparatus is being used by an automobile manufacturer to check the depth of coats of lacquer on car bodies.

DEVICE MEASURES REFLECTED LIGHT

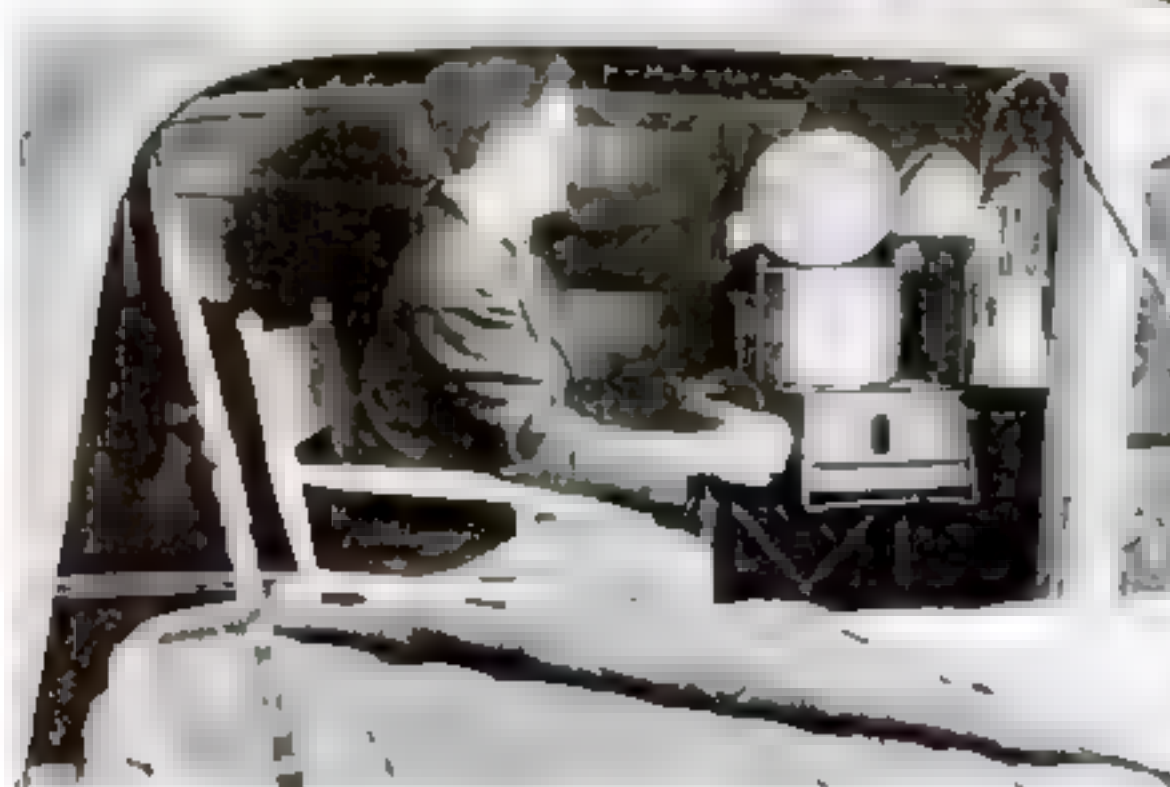
LIGHT reflected from a flat surface, or transmitted through a transparent or translucent material, is quickly gauged by a new electrical device. A surface to be tested for reflection is placed against an opening in a hollow metal sphere, into which light is directed along a tubular arm, and the amount of light reflected is measured by an "electric eye." Transparent or translucent materials for test are placed between the recording sphere and another globe containing a lamp.



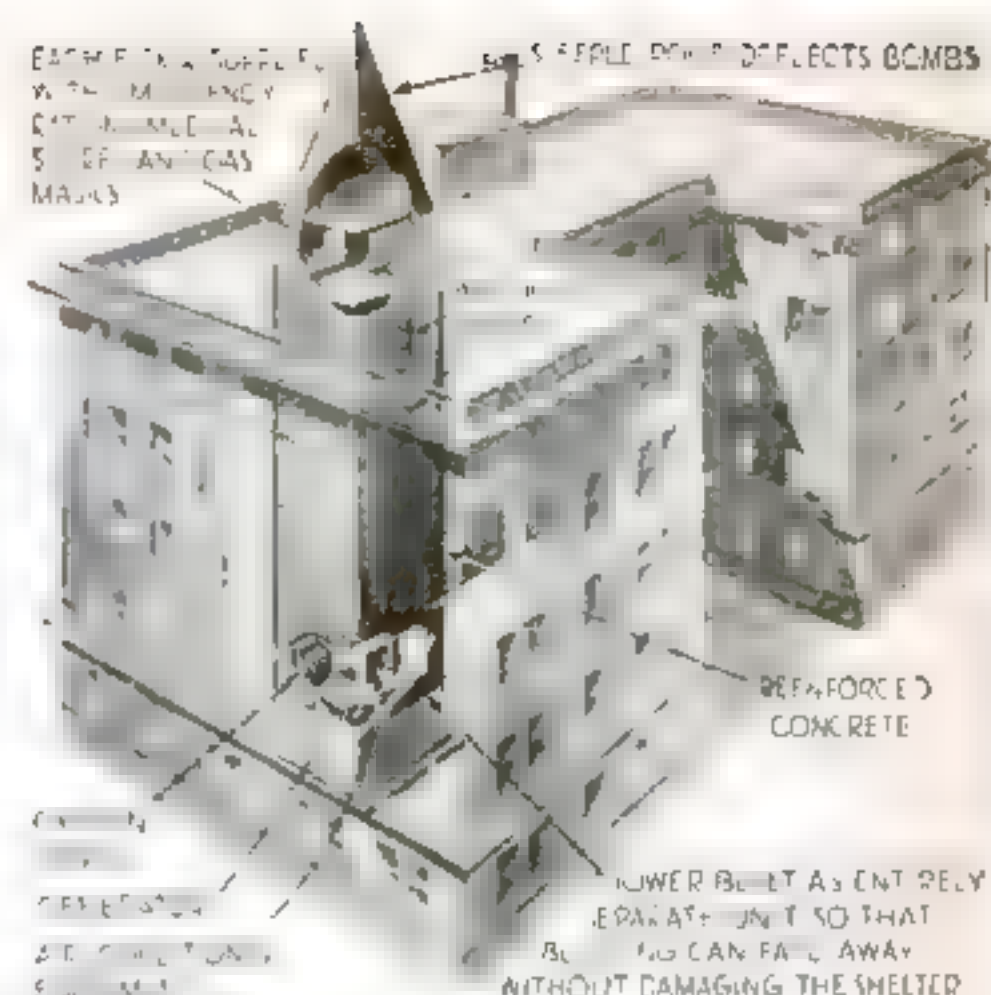
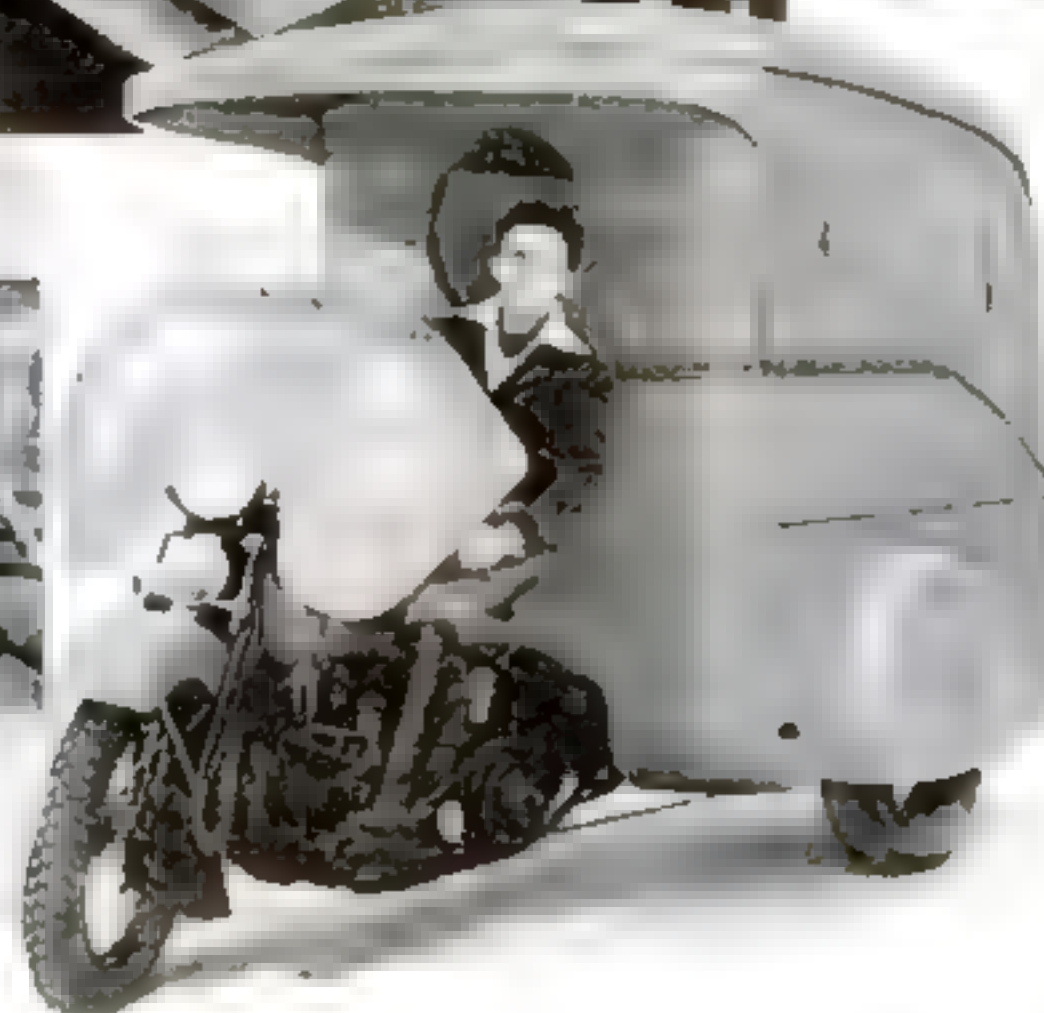
The reflection-measuring device in use, at left, for testing a flat wall surface and, above, to gauge the light transmitted through a slab of translucent material

USE MOTOR-CYCLE COACH ON LONG TRIP

ON A 20,000-mile trip through remote sections of Asia and Africa, two American missionaries will use the novel three-wheeled motor-cycle coach illustrated. While one drives from the conventional motor-cycle saddle, the other will ride within the aluminum body, which is insulated with asbestos and will serve as a kitchen, photographic darkroom, and storage compartment. At night, side wall panels swing outward to form supports for sleeping bags. Tanks will hold enough gasoline for 1,000 miles.



Three views of the odd, three-wheeled vehicle in which two American missionaries will make a 20,000-mile trip



BOMBPROOF TOWERS PUT IN BUILDINGS

TO PROTECT civilians during wartime bombing raids, an Italian inventor has devised a re-enforced concrete shelter tower that will be built into a building like an elevator shaft. At each floor level, air-tight doors lead into shelter rooms stocked with food and medicine. A sharply sloping roof is designed to deflect aerial bombs, while the tower base houses a power plant and air-conditioning equipment to supply light and ventilation.

LIGHT AIR-MAIL PAPER

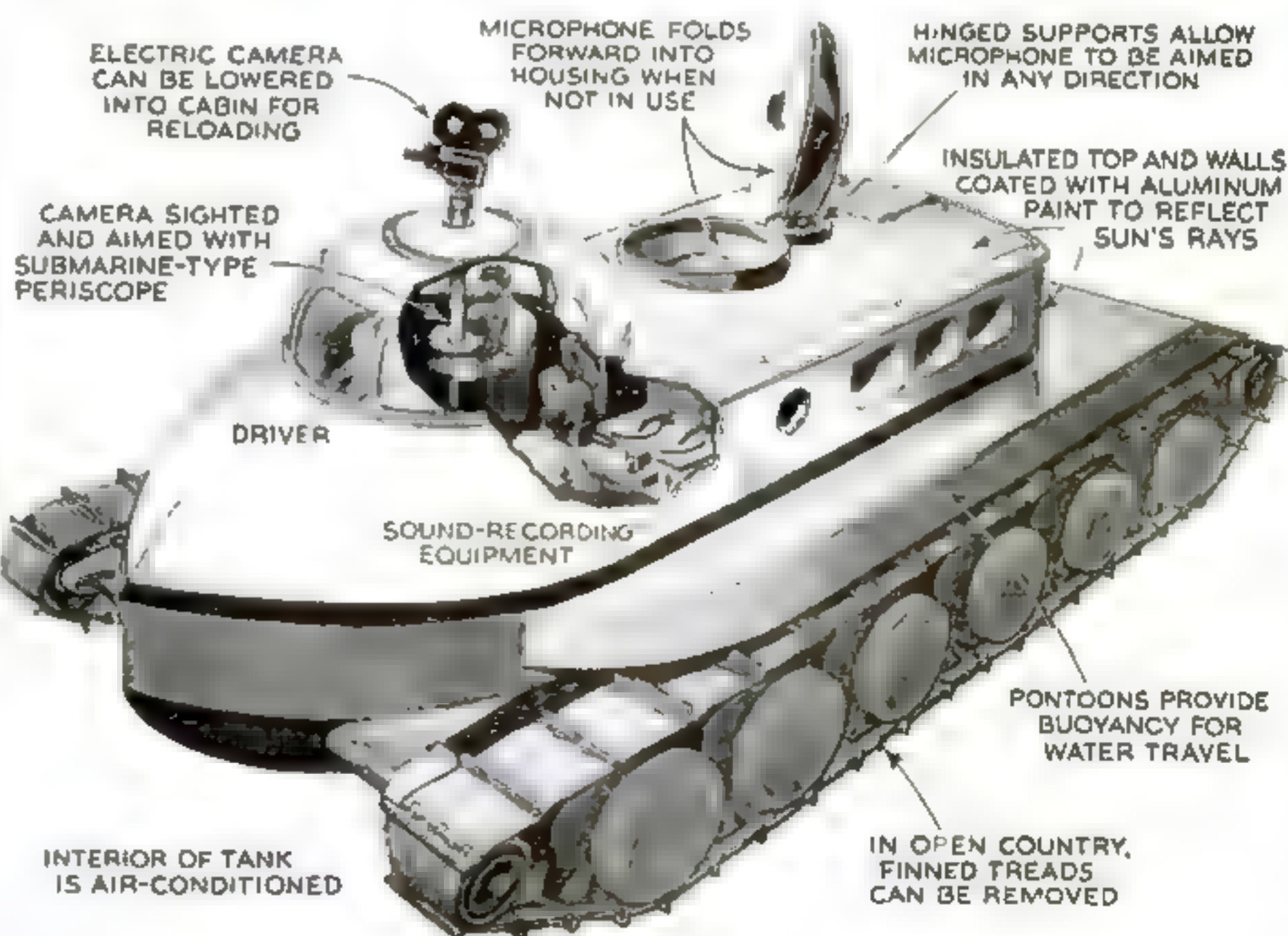
TO ENABLE business firms to use air-mail service for their regular correspondence, British paper makers have developed a lightweight writing paper that is said to weigh only an ounce for sixteen sheets. It also is reported to be strong enough for typewriter use, and so opaque that writing does not show through.

GOLF CLUB FOR PUTTING HAS ADJUSTABLE WEIGHT

BECAUSE the weight of the head can be adjusted, a golf club of new design is said to insure more accurate putting. Lead slugs, contained in a cylindrical housing placed at right angles to the club face, may be removed singly until the putter has just the weight desired. The heavy cylinder tends to make the club swing in a straighter line, and helps control it, assuring straighter putts, it is claimed.



Lead slugs in the cylindrical head may be removed to vary the weight



TRACTOR TANK TO GET JUNGLE MOVIES

RUMBLING through dense jungles, a powerful amphibian tank now under construction will serve as a mobile home and laboratory for European explorers who plan to make sound movies of tropical wild life. Fully insulated against heat, the vehicle will run on finned treads that will propel it on water as well as land. The finned tractor treads can be removed when the

tank is to traverse long stretches of open country, making it possible to attain higher speeds. An outside microphone, connected to sound-recording apparatus within the cabin, can be moved to "focus" on a bird or animal, while a projecting camera is sighted by means of a periscope. The camera comes down through the cabin cap for storage or reloading.

MODEL CARS TEST DRIVERS' JUDGMENT



Woman driver and test operator controlling separate models on tracks

RUNNING along tracks mounted on a table, model automobiles operated by remote control provide a new test that is designed to check car drivers' ability to judge speed and distance. Seated at one end of the testing table, the motorist regulates the speed of one car by means of a foot pedal, and attempts to avoid a crossing collision with a second car that is controlled by the testing operator. The device is used at a "traffic clinic" for the education of Detroit, Mich., drivers.

This simple sextant has an artificial horizon



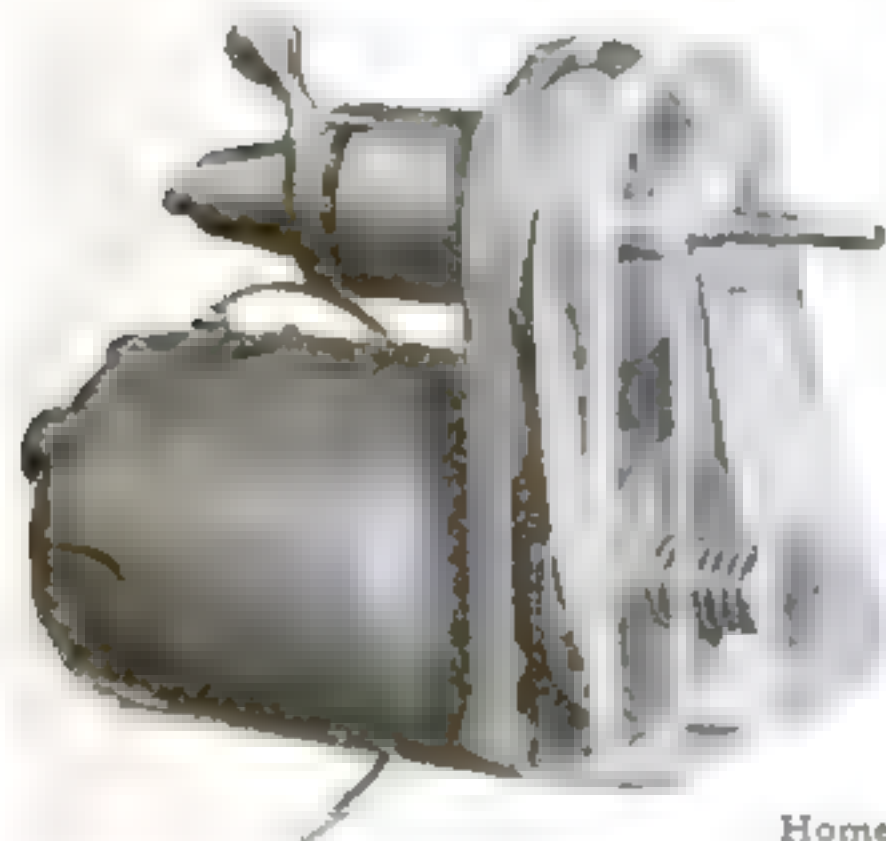
SEXTANT FOR AMATEURS IS INEXPENSIVE

AN INEXPENSIVE sextant just marketed for popular use is a handy instrument for position finding, navigating small boats, mapping, and measuring distances. Equipped with an artificial horizon for use when the real horizon is difficult to see, the instrument has a vernier control for making angle measurements as small as half a degree. When properly sighted and read, the sextant is said to indicate latitude and longitude within three miles.

GAS ALARM FOR SCHOOLS

GAS-ALARM bells, similar to systems that give warning of fire, are recommended by an explosives expert of the U.S. Department of Commerce as required equipment in all schools heated by gas. At the first sign of leaking fumes, alarm bells would ring in halls and classrooms.

MULTISPEED HOME-WORKSHOP DRIVE



Home-workshop drive in use on a lathe and, at left, with its working parts exposed. Belts and pulleys are fully inclosed

WITHOUT stopping the motor or shifting a belt, home-workshop machines equipped with a new multi-speed drive can be regulated to the ideal speed for any type of work. Turning a control lever widens or narrows the sheaves of two split pulleys so that their effective diameters change, thus altering the speed of the spindle to produce clean work on pieces of differing diameters.



ARTIFICIAL ANGLEWORMS FOOL HUNGRY FISH

ARTIFICIAL worms for use as fish lure have just been marketed to relieve anglers of the trouble of digging up their bait. Made of natural fish food, the synthetic worms actually crawl and squirm when stretched or coiled. The makers claim that the artificial bait gets as good fishing results as real worms.

FOLDING TRAILER BED SLEEPS THREE

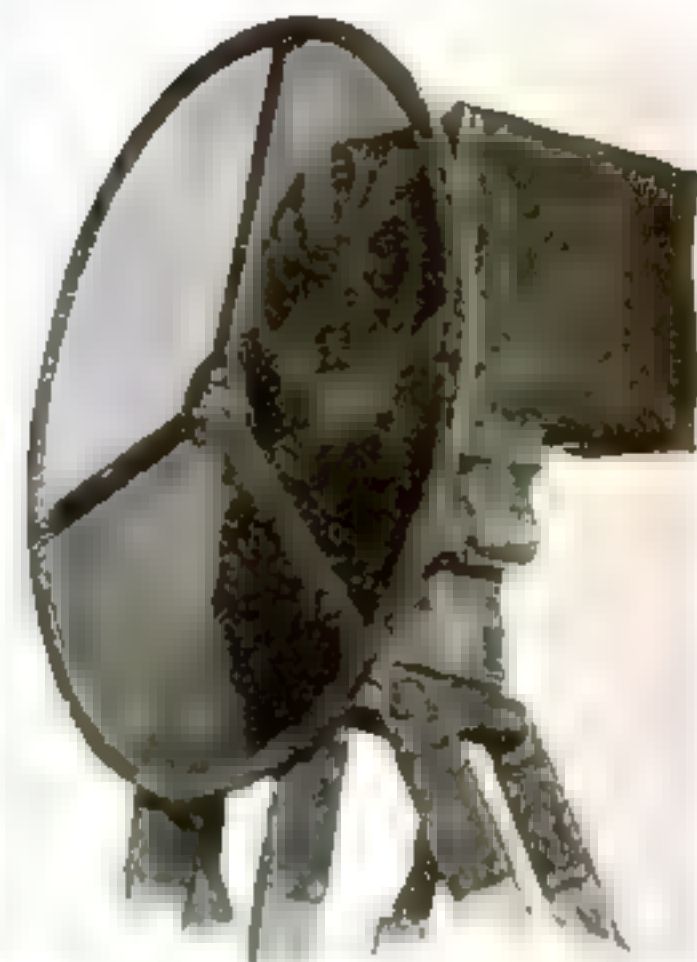
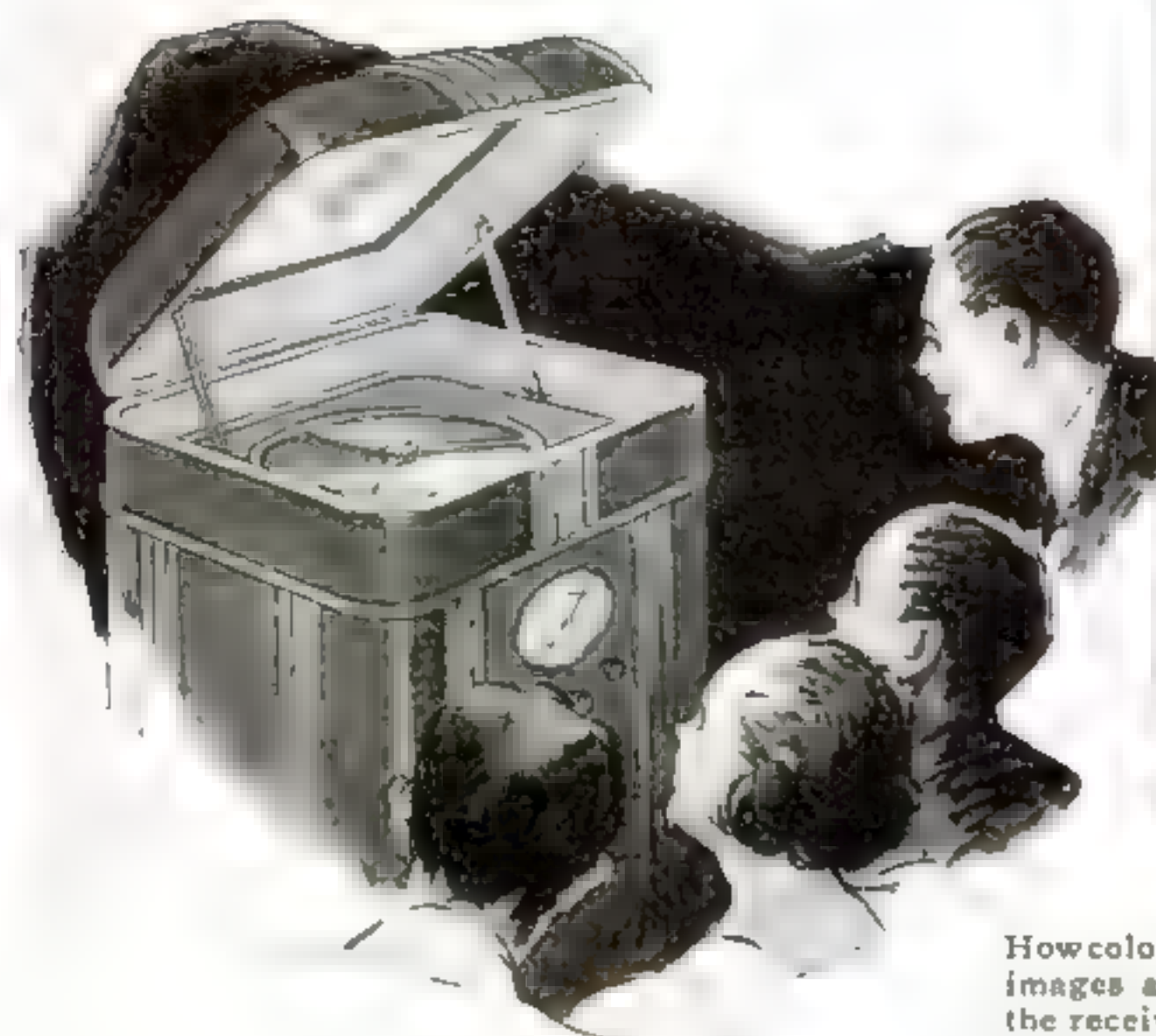


At the right, the bed is opened out. Drawings show how various parts fit together in a small, compact unit

COMFORTABLE sleeping accommodations for three people are provided by a new folding bed designed for trailer use. Serving as a divan by day, the unit becomes a double-deck bed when the back is swung upward to form an upper berth. The bottom section, which is utilized for storage of bedding, slides forward to form half of a double bed; or it may be detached for use as a separate single berth. Each berth has its own inner-spring mattress.



Television Pictures Shown in Color



How colored television images are viewed in the receiver. Above is the mechanical receiver unit and, at right, a transmitting camera fitted with color disk

TELEVISION pictures in natural colors are said to be transmitted with the aid of a new device recently perfected by a Los Angeles, Calif. inventor. A color disk, divided into sectors of red, green, and blue-violet, is whirled in front of the television scanning lens to break down the images into the three primary colors of light. One picture is thus transmitted and received as three separate images. Another whirling disk, also divided into the three color sectors, is placed in front of the receiver's projecting lens and rotated synchronously with the transmitter's color disk by means of an automatic control. Although every view is broken into three images of different color, each appearing on the screen in turn, the process is so rapid that the eye sees the pictures blended into the natural hues of the original, just as paints of the three primary colors can be mixed to produce any desired shade.



A picture as recorded by the three variously colored sectors of the revolving disk. In the receiving apparatus, these three images are blended to produce a picture in natural colors on the viewing screen

ODD PAINTINGS GIVE EFFECT OF DEPTH



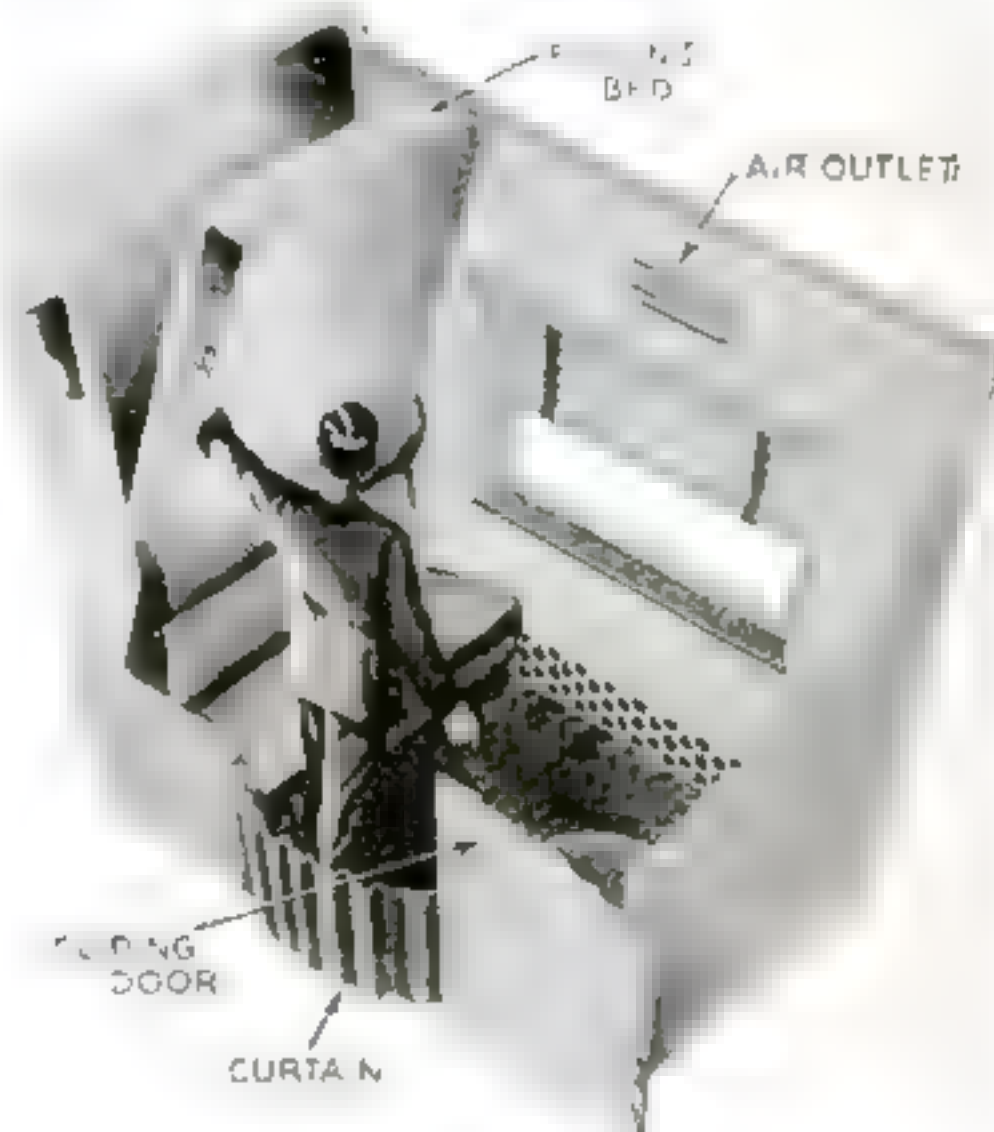
PAINTED on the inside of a hemispherical shell made of papier-mâché, novel pictures created by a New York artist give a three-dimensional effect when seen from a certain point. Although at first glance they appear distorted, the paintings are "focused" by adjusting the stand on which they are mounted so that the observer can view them from the correct focal point.

"RAINCOAT" KEEPS HAT DRY

MEN can now protect their hats from rain without carrying an umbrella. An odd rubber "hat raincoat," just invented in Italy, slips over the crown and brim. Made in various colors and sizes, the hat protector can be folded into a compact package, small enough to be carried conveniently in the user's pocket.



"Hat raincoat" being taken from its pocket case. Left, how it is slipped over the crown and brim



SLEEPING-CAR BERTH FOLDS INTO WALL

HINGED at one end, a new type of sleeping-car berth swings up into an end wall when it is not in use. Built for an inclosed compartment of new design, the berth fits compactly into a storage niche behind the seat back, as shown in the illustration above. Venetian blinds, ventilator, and shelf for ice-water bottle and glass are other features of the combined day-and-night railroad stateroom. A heavy curtain and sliding door assure privacy.

The artist showing how his concave paintings are viewed to give a three-dimensional effect

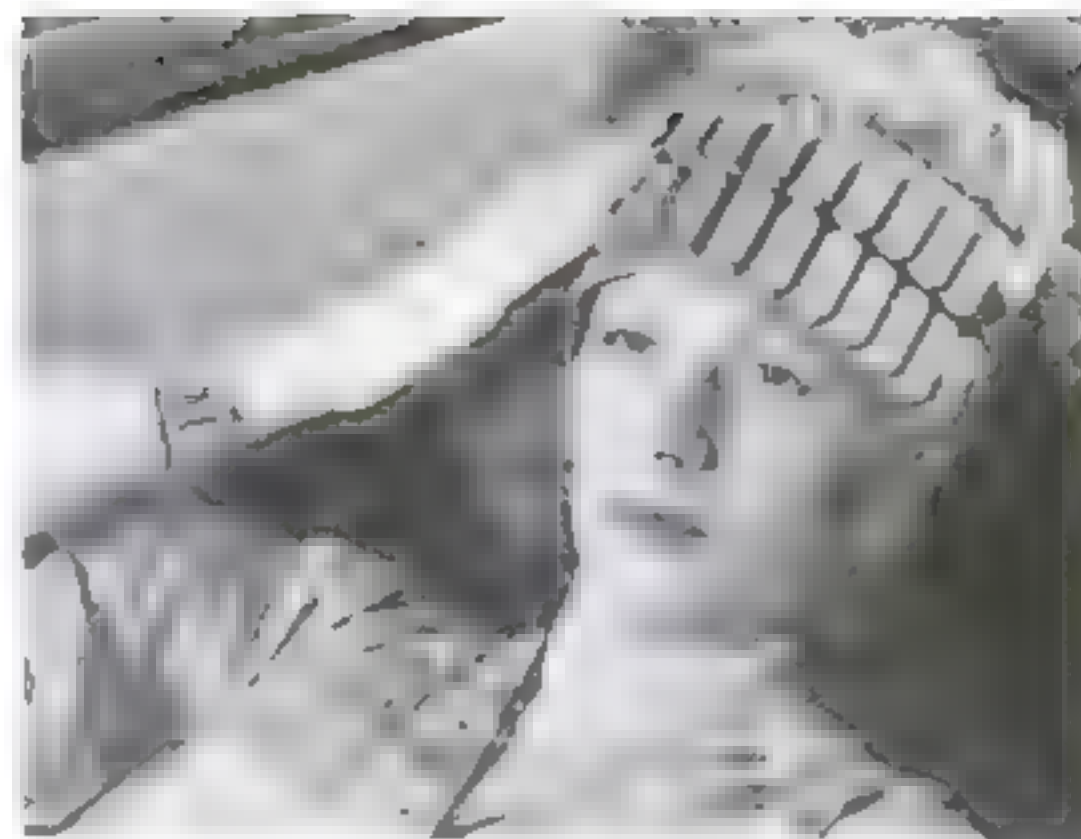
ODD LAMPS MADE FROM WOODEN SHOES



From his hobby of making toy sailboats out of wooden shoes, Alex Bouwens of Inglewood, Calif., has developed a thriving business in novelty lamps. In his garage workshop, Bouwens sets masts and rigs sails on shoes imported from Holland, and then wires them for use as decorative table lamps.



Wooden shoes imported from Holland. The inset shows one being rigged as a sailboat lamp



SEALED-IN ICE CUBES CHILL RUBBER PACK

A new rubber ice pack for relieving headaches and for general sick-room use is cooled by placing it in the icing compartment of a refrigerator. Smooth on the side which is applied to the body, the sack consists of a double row of sealed rubber sections which are filled with a liquid that freezes in forty-five minutes and keeps ice-cold for one hour. The accessory also can be made to serve as a hot pack by immersing it in hot water. A second pack may be heated or cooled while the first is in use.



Ice pack being placed in refrigerator to freeze liquid sealed in the rubber sections

Brayton Eddy, curator of the insect zoo, with a trap for catching specimens

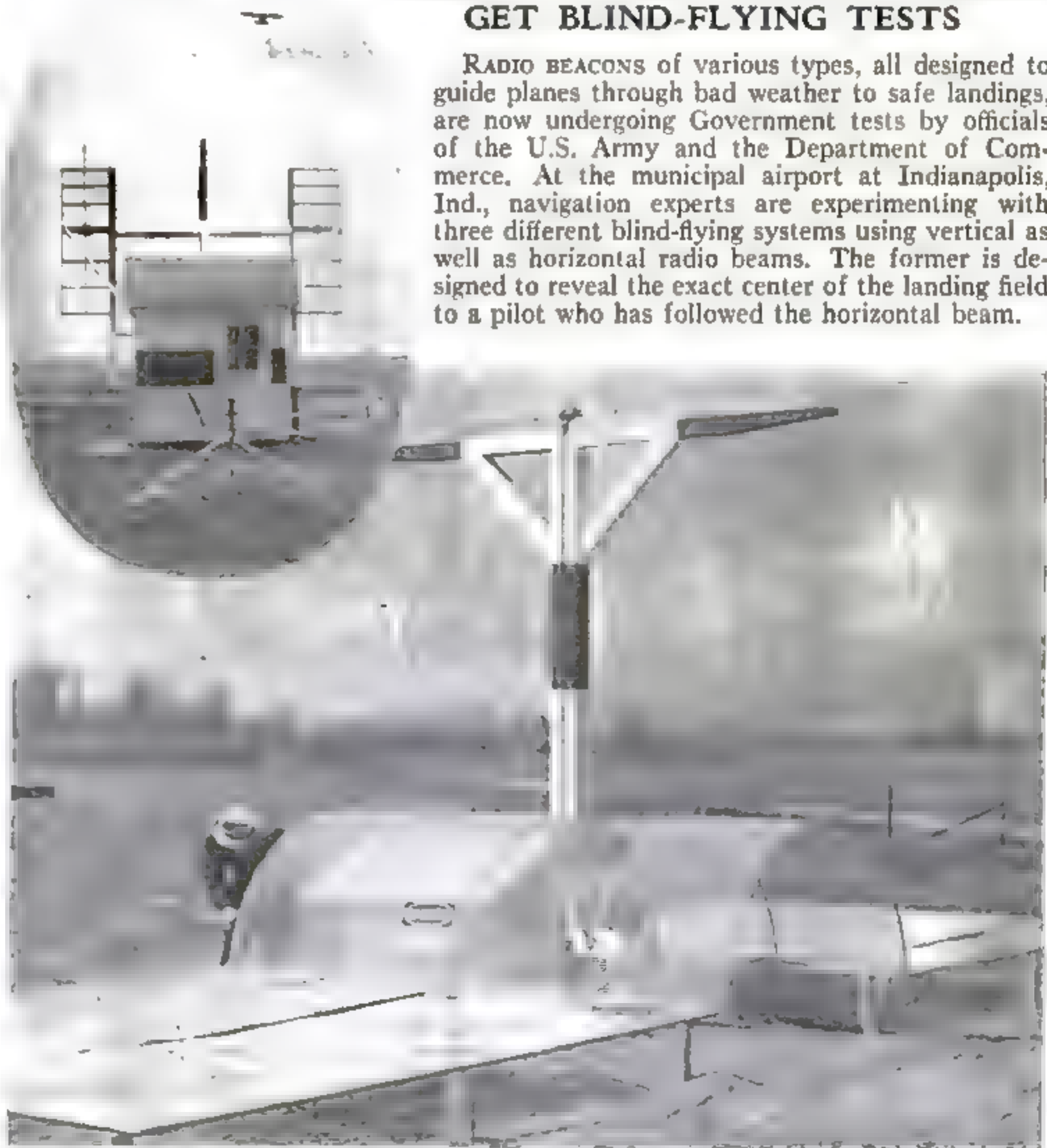


TRAP CATCHES INSECTS FOR NOVEL BUG ZOO

SAID to be the first of its kind in the United States, an insect zoo will soon be open to the public in Detroit, Mich. Brayton Eddy, curator of the odd zoo, is shown above with a trap for catching live specimens.

VARIOUS TYPES OF RADIO BEACONS GET BLIND-FLYING TESTS

RADIO BEACONS of various types, all designed to guide planes through bad weather to safe landings, are now undergoing Government tests by officials of the U.S. Army and the Department of Commerce. At the municipal airport at Indianapolis, Ind., navigation experts are experimenting with three different blind-flying systems using vertical as well as horizontal radio beams. The former is designed to reveal the exact center of the landing field to a pilot who has followed the horizontal beam.



Novel antenna for vertical radio-beacon beam. In oval, a plane coming in on the horizontal beam

FAN BLOWS 'CHUTE JUMPERS INTO AIR



Parachute ascending on a column of air. At the right, a jumper is about to "take off" from the platform that covers the horizontal propeller

BEGINNERS at parachute jumping are blown as high as 250 feet from the ground by a novel fan-type catapult recently designed in Russia for training flyers. Powered by an electric motor, a giant horizontal propeller creates a strong vertical current which blows the jumper, strapped into an automatically stabilizing parachute, straight up into the air. The jumper then manipulates the 'chute shroud lines to maneuver down to a landing, just as if he had leaped from an airplane.



AIR BUBBLE INDICATES BRAKE-DRUM BALANCE

BRAKE DRUMS for installation on automobiles of a popular make are accurately checked for balance by the sensitive testing device shown in the photograph above. When the drum is set into position on the apparatus, a workman watches a circular dial, under the glass cover of which an air bubble floats in a liquid. If the bubble comes to rest in the dead center of the dial, the brake is considered to be in exact balance.

TRAILERS MOVED EASILY WITH NEW HAND TRUCK

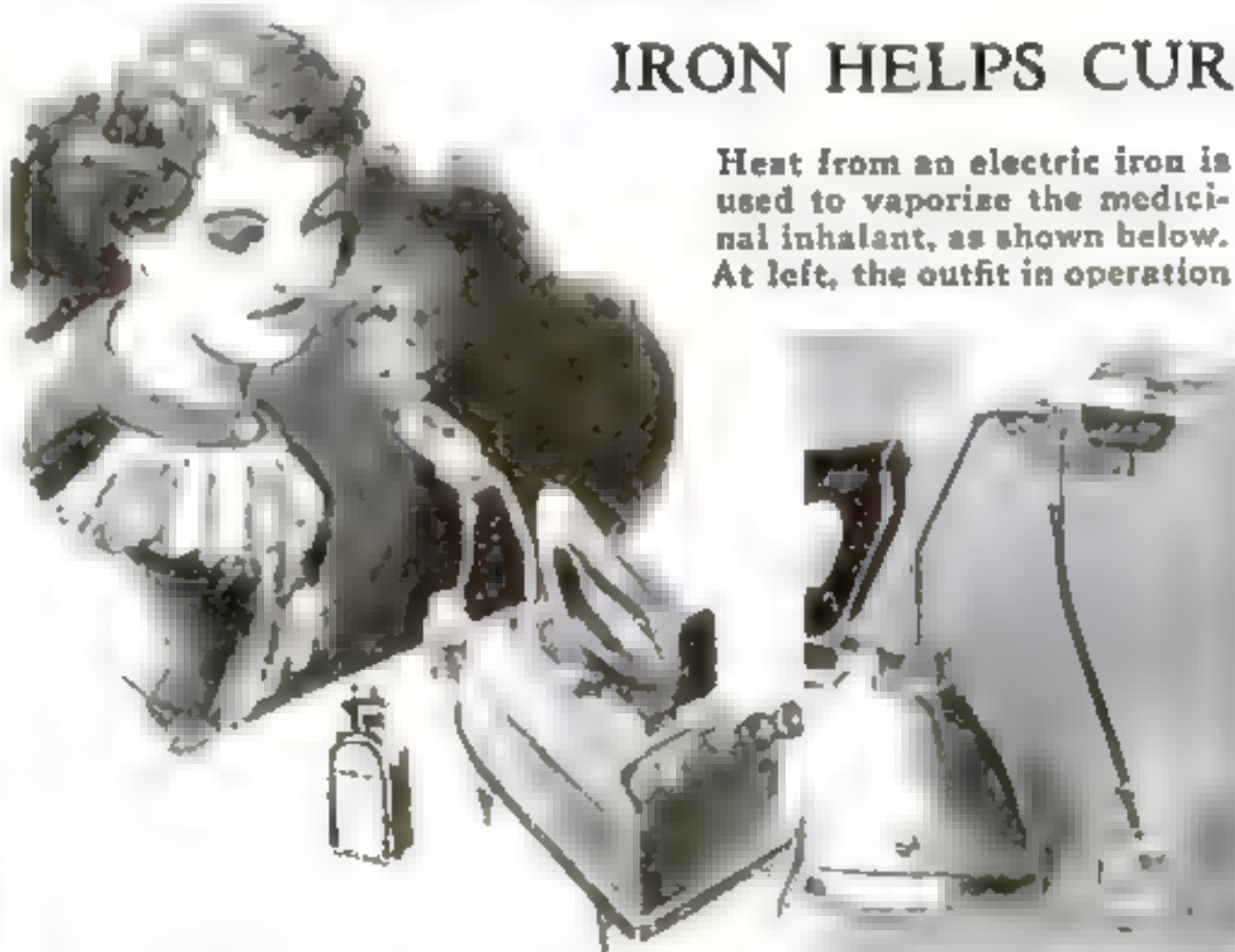
RESEMBLING a bladeless lawn mower equipped with balloon tires, a new unit makes it easy to move a trailer unhitched from a car. When the device is wheeled under the coupling and the handle pressed down, a vertical post lifts the trailer's nose clear of the ground. Thus, parking and maneuvering in cramped areas is accomplished with greater ease, it is claimed, than is possible with the ordinary built-in metal caster wheel.



Two views of the hand truck for moving trailers. Placed under the hitch, it lifts the nose clear

IRON HELPS CURE HEAD COLDS

Heat from an electric iron is used to vaporize the medicinal inhalant, as shown below. At left, the outfit in operation

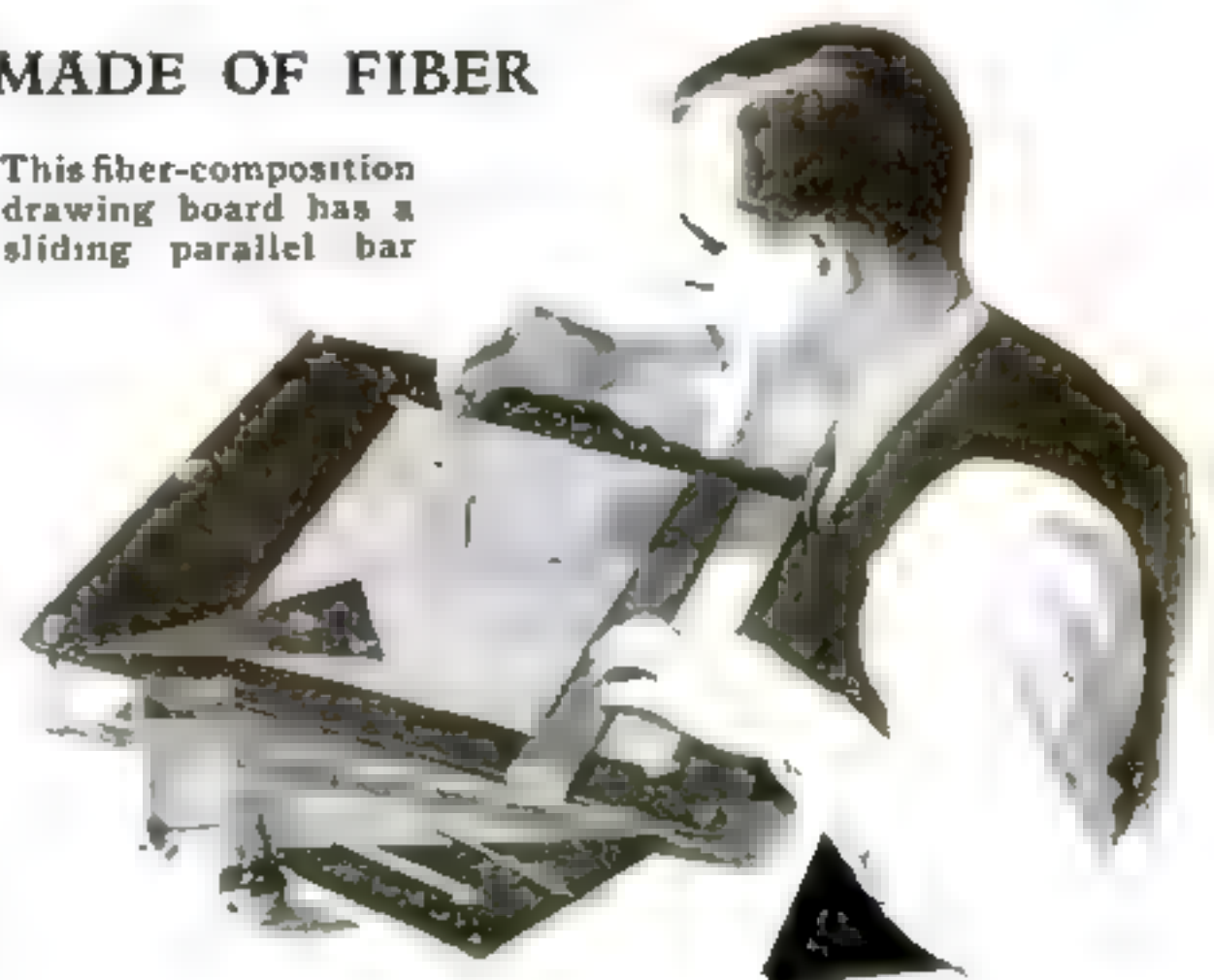


AN INGENIOUS inhalator for treating head colds utilizes an electric iron as a heating element. Devised by an Austrian inventor, the device has a glass breathing unit connected to two small metal tubes, one leading to the iron and the other to a bottle containing a medicinal inhalant. Vaporized by the heat, the inhalant is emitted as a stream of soothing fumes for the treatment of respiratory disorders.

DRAWING BOARD IS MADE OF FIBER

MADE of a hard, fibrous material, a new drawing board is said to stay permanently square and flat, with no warping or cracking. Held at the correct drawing position by rubber-tipped steel supports, the board has a sliding parallel bar permanently attached to its sides for use in place of the common T square. According to the makers, neither oils, water colors, nor moisture will damage the fiber surface. Paper is fastened to the board with tabs of adhesive tape at the corners instead of thumb tacks.

This fiber-composition drawing board has a sliding parallel bar



YOU CAN BE A Plant Wizard

By Arthur Hawthorne Carhart

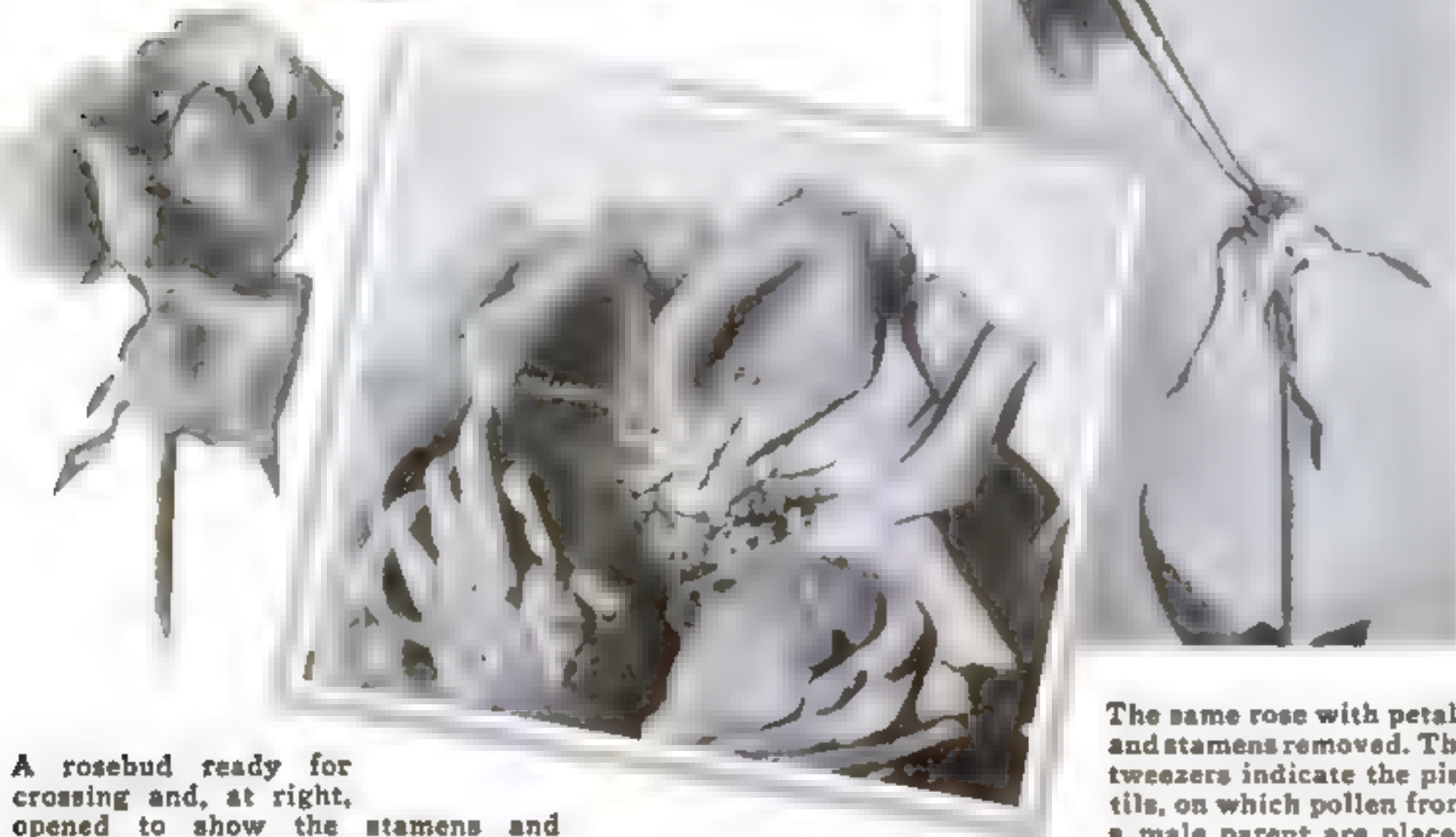


ANYONE who produces a new plant variety generally gets called a "plant wizard." That term alone is enough to make the average hobbyist shy away from the field of plant breeding. As in many another activity, however, once the hocus-pocus is stripped away, the amateur will find in the creation of new plant varieties an engaging and genuinely adventurous spare-time activity. Furthermore, unlike some hobbies, this one offers a good chance for financial returns.

It must be admitted at the start that plant breeding in its deeper ramifications is an intricate study. At times, it baffles the most expert. But, if you wish, you may be a "plant wizard" in your own back yard. A limited number of flowers in the home garden, common garden instinct, knowledge of basic steps required, and a steady hand are all that are needed to produce new-type seedlings.

The essential part of producing new plant varieties is artificial cross-pollination. Anyone may succeed in doing this. The first step is to decide what species you will work with. Annual plants give quick results. They show the results of crossing in blooms from seed the following year. Sweet peas, marigolds, snapdragons, and cosmos are examples of these annual flowers. Perennials, such as irises, bulbous plants like tulips and gladioluses, require several seasons before blooming. Roses and other woody plants need a longer period. Patience is indispensable in dealing with slower-maturing species. A new variety of apples may not prove itself for seven to ten years, and, of course, fruits require more space than an average home affords.

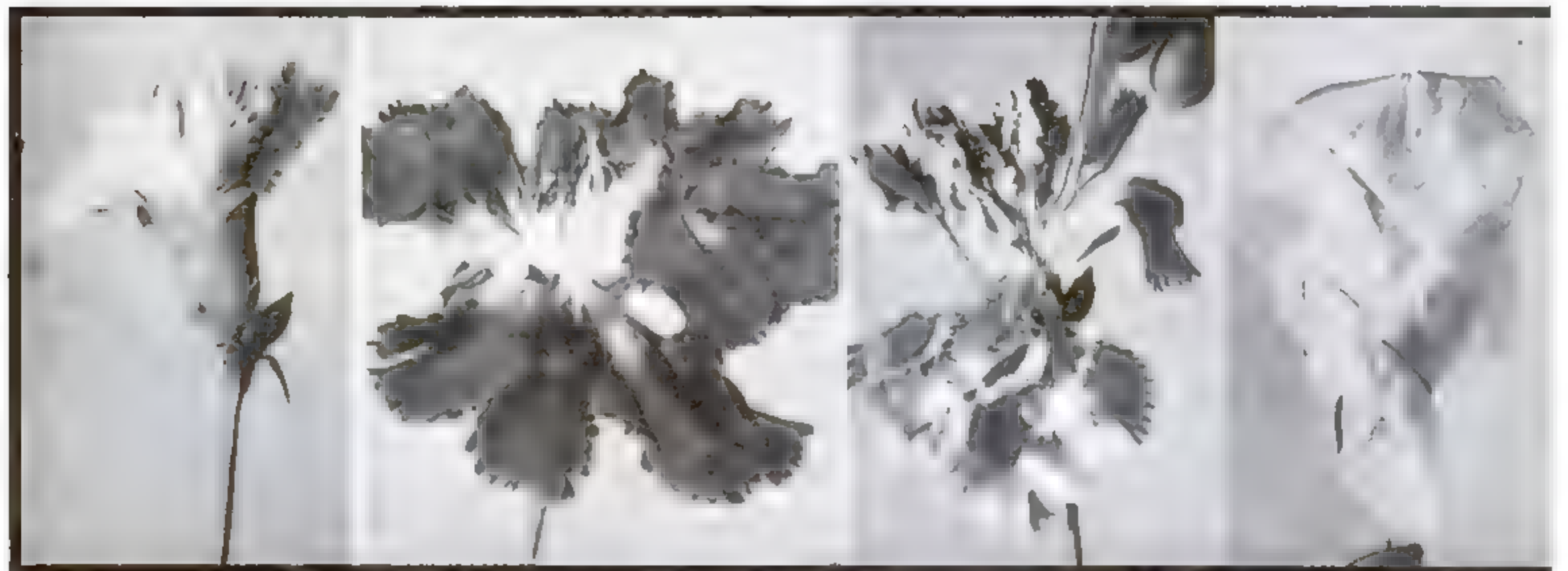
Amateurs will find irises, gladioluses,



A rosebud ready for crossing and, at right, opened to show the stamens and the pistils which receive the pollen

The same rose with petals and stamens removed. The tweezers indicate the pistils, on which pollen from a male parent are placed

HOW TO CROSS-POLLINATE CARNATIONS . . A SIMPLE EXAMPLE



- 1 The flower selected for the female parent must be in bud
- 2 Break the flower open, folding the petals back to expose the stamens and pistil
- 3 With a pair of tweezers, pluck out the still immature stamens
- 4 Cover the emasculated bloom with protective waxed paper

sweet peas, and snapdragons easy to work with. Among vegetables, tomatoes, garden peas, and the melon family are easy fields.

Preliminary to crossing, ascertain whether the plant you are planning to hybridize produces "complete" or "incomplete" blossoms. The former carries both male and female elements of the flower in one bloom. The latter produces male elements in one flower, female in another.

From school botany we learn that the male element is the anther or pollen bearer, and the female element is the pistil, attached at its base to the ovary, which develops into the seed pod. Generally, in a "complete flower," the stamens will be found in a location around the pistil, so that wind or insects will jar the tiny grains loose so they drop on the pistil and complete the act of fertilization. So, in order to make sure you really have crossed two varieties, you must remove the stamens of the flower to be pollinated before the pollen becomes ripe and breaks out dustily to impregnate the female element.

After you have selected a female parent for your experiment in hybridizing, break open a flower that is still in bud. With a pair of tweezers, using a magnifying glass if flower parts are small, pluck out the stamens. If your magnifying glass reveals the stamens ripe and dusty, the flower has not been prepared early enough. Take another, less mature.

After the immature stamens have been removed, cover the emasculated flower with a square of waxed paper to prevent insects or other agencies from causing a "wildcat" cross. After several days examine the pistil. If the surface shows gummy under the hand glass, it is ready for pollen.

Select a male parent with ripe pollen, and transfer some grains to the female parent. One accepted way is to dust off ripe pollen into a clean watch glass, pick it up with a small camel's-hair brush, and apply it to the pistil's gummy surface. A more direct way is to lift a ripe stamen from the male parent with tweezers, carry it guardedly to the female parent, and apply the dusty pollen directly. Looking through the (Continued on page 112)

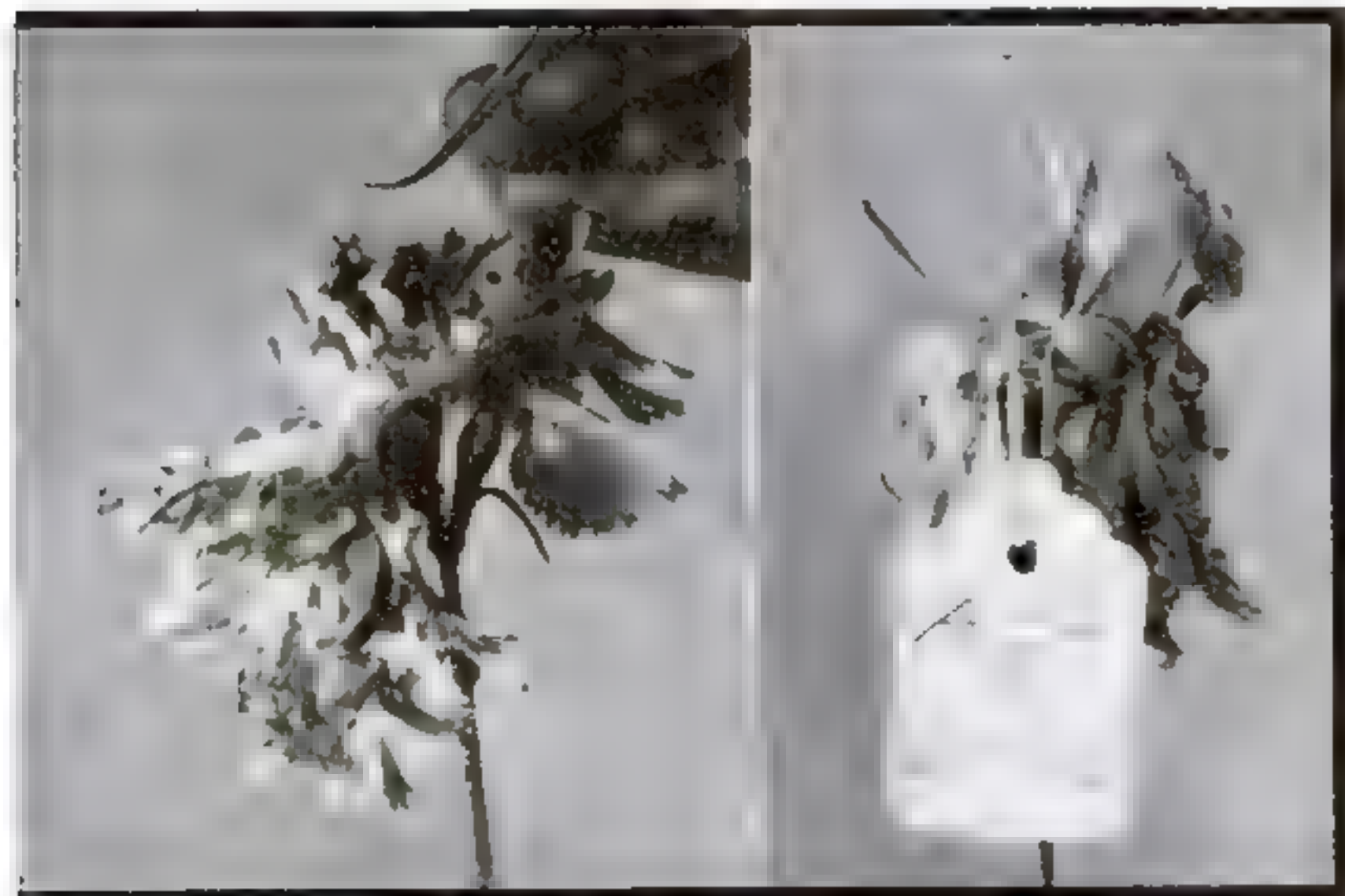
By crossing the pink carnation at the upper left with the red at the upper right, the author produced seeds from which grew an improved pink (at lower left), an improved red (at lower right), and an entirely new color in carnations, apricot, seen in the center



Tweezers removing stamens from a sweet-pea bloom. The upper bloom still has its covering

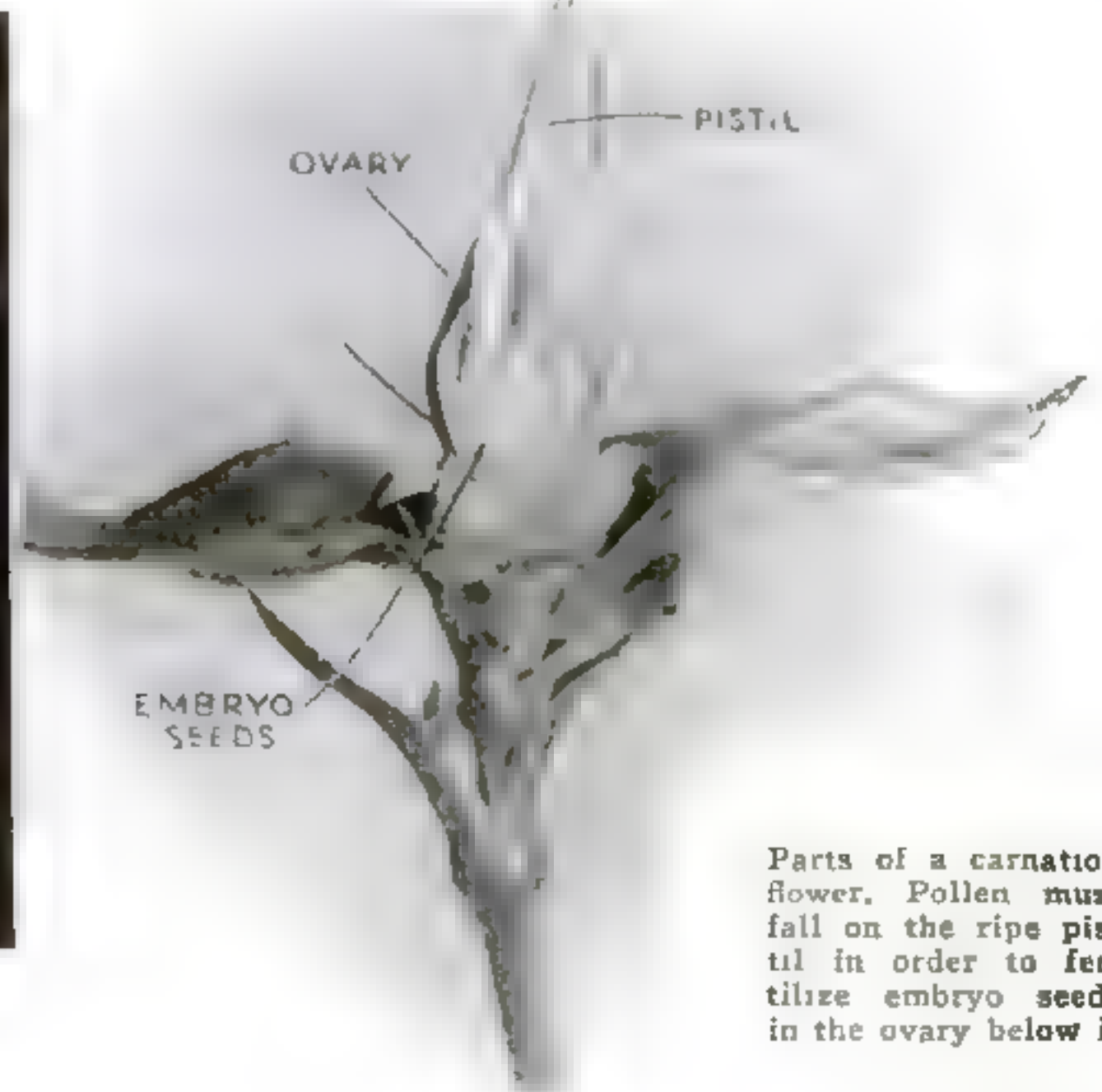
At far left is a marigold with part of its stamens plucked. Left, the flower being pollinated with the stamens of another parent

OF ARTIFICIAL PLANT BREEDING



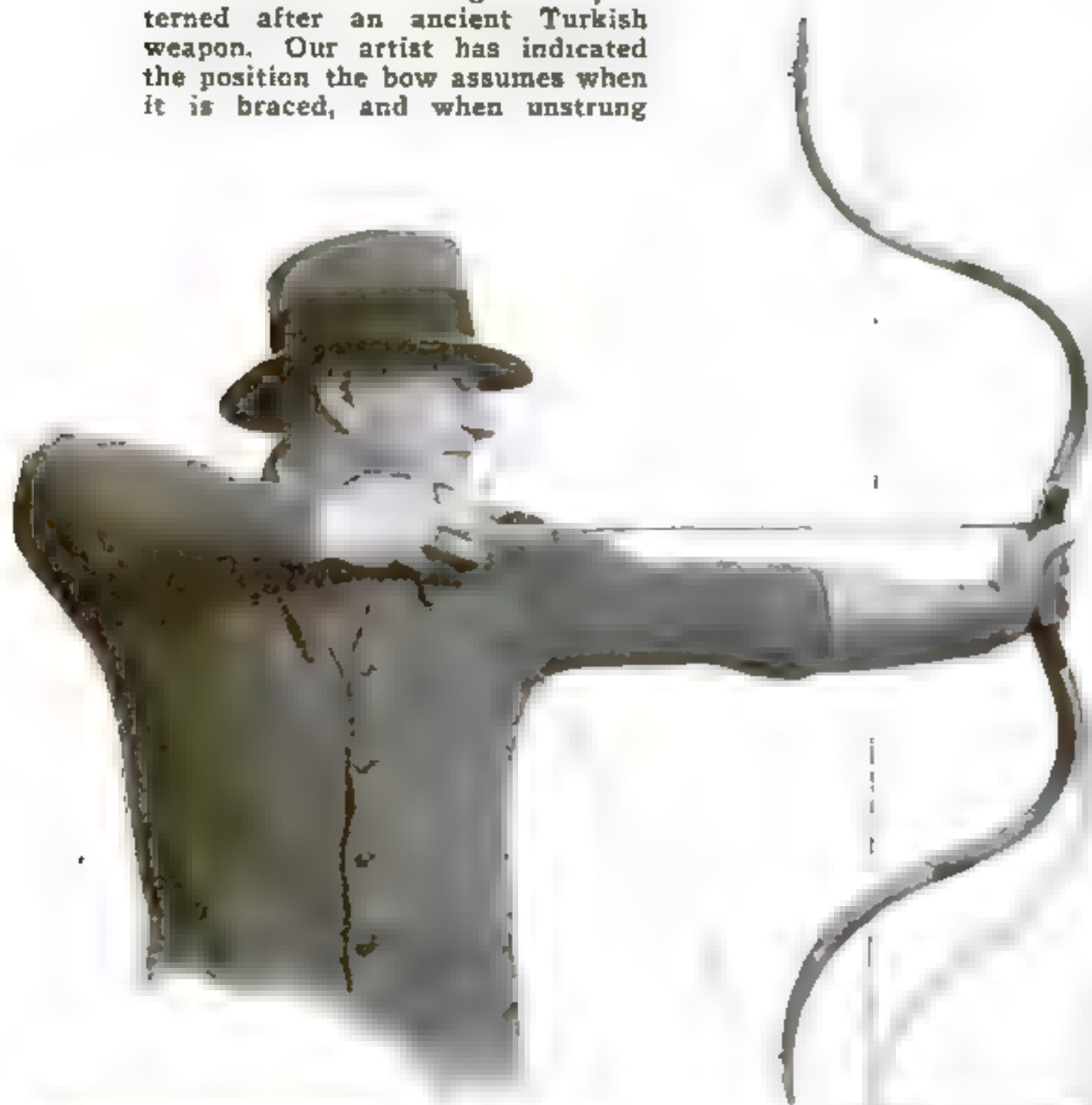
5 When the pistil is ripe, select a stamen from the male parent and apply pollen

6 Tag the cross-bred stalk to show the parentage of the coming seeds



Parts of a carnation flower. Pollen must fall on the ripe pistil in order to fertilize embryo seeds in the ovary below it

L. E. Stemmler drawing a bow patterned after an ancient Turkish weapon. Our artist has indicated the position the bow assumes when it is braced, and when unstrung



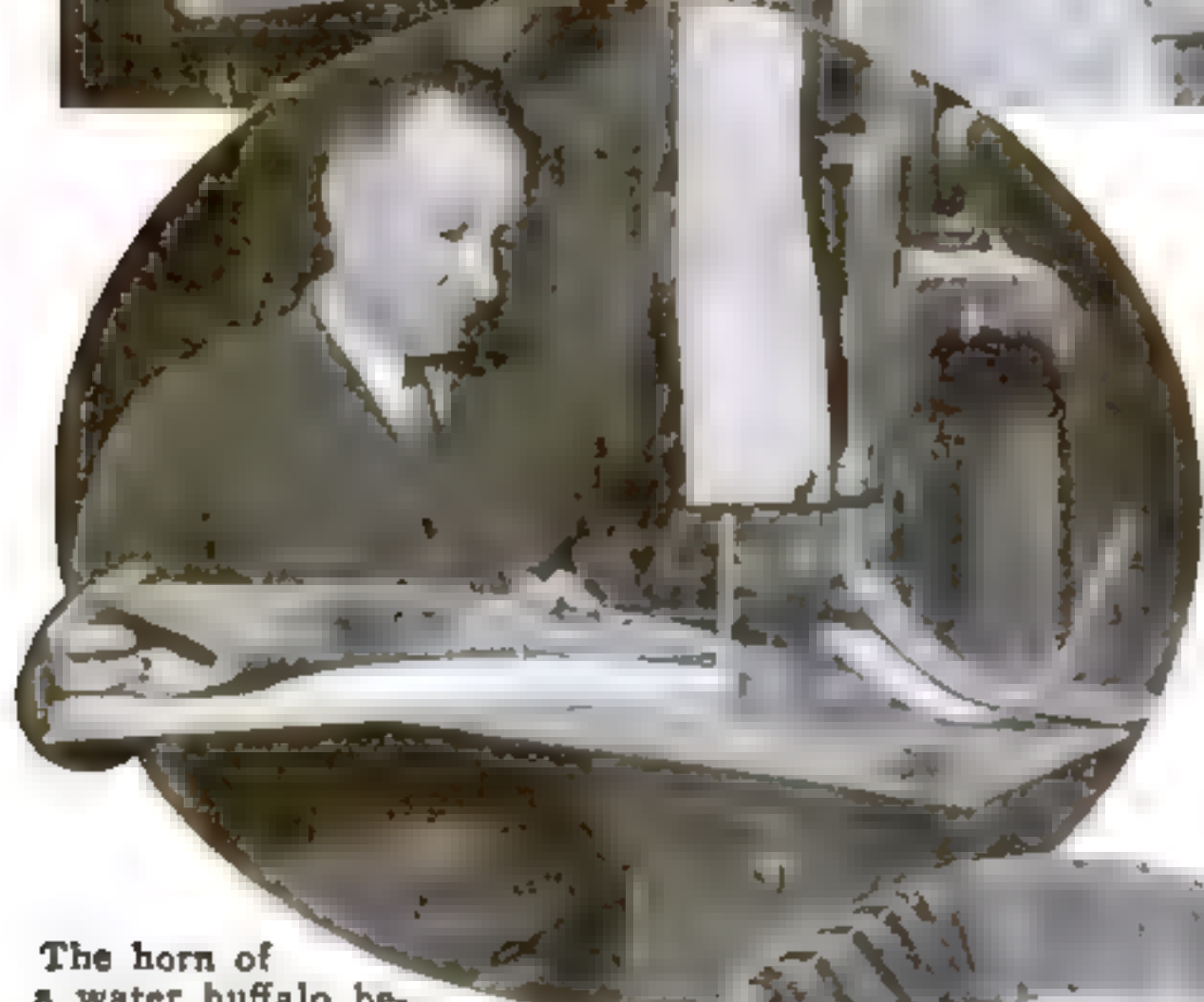
Ancient Oriental Bows

REPRODUCED BY
MODERN ARCHER

INSPIRED by half-legendary accounts of oriental archers who shot arrows over 800 yards—almost twice the modern flight record—L. E. Stemmler, well-known bowman, recently succeeded in producing modern copies of early Turkish and Persian bows, long held to be the finest bows ever made. Expensive and extremely difficult to construct, the composite oriental bow combines animal horn and sinew with wood to give it tremendous strength, flexibility, and power. Following plans worked out in coöperation with Stephen V. Grancsay, curator of arms and armor at New York's Metropolitan Museum of Art, Stemmler imported horns of the Asiatic water buffalo and the yak, the only animal horns in the world that have the necessary combination of toughness and resiliency. After a year of experimentation, laminated strips of fine lemonwood and hickory were found to make the best core. Shredded animal sinew was matted to the bow core with a special glue that required months to concoct. Although not as powerful as some ancient types, the first bow he completed had such a heavy draw that Stemmler did not have the strength to shoot it. He now scales down his bows so that present-day archers can use them.

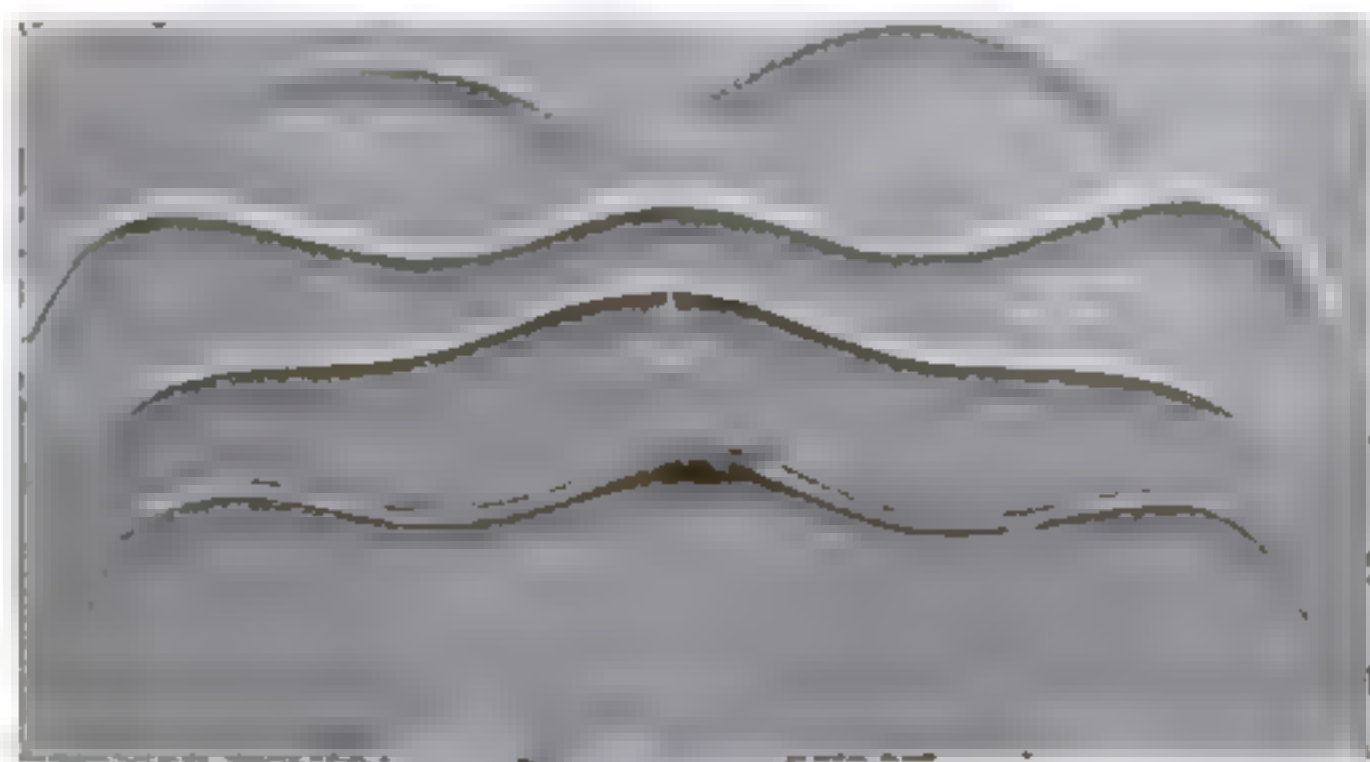


The core, made of laminated strips of lemonwood and hickory, being removed from a form on which it was built up with glue



The horn of a water buffalo being sliced with a hand saw

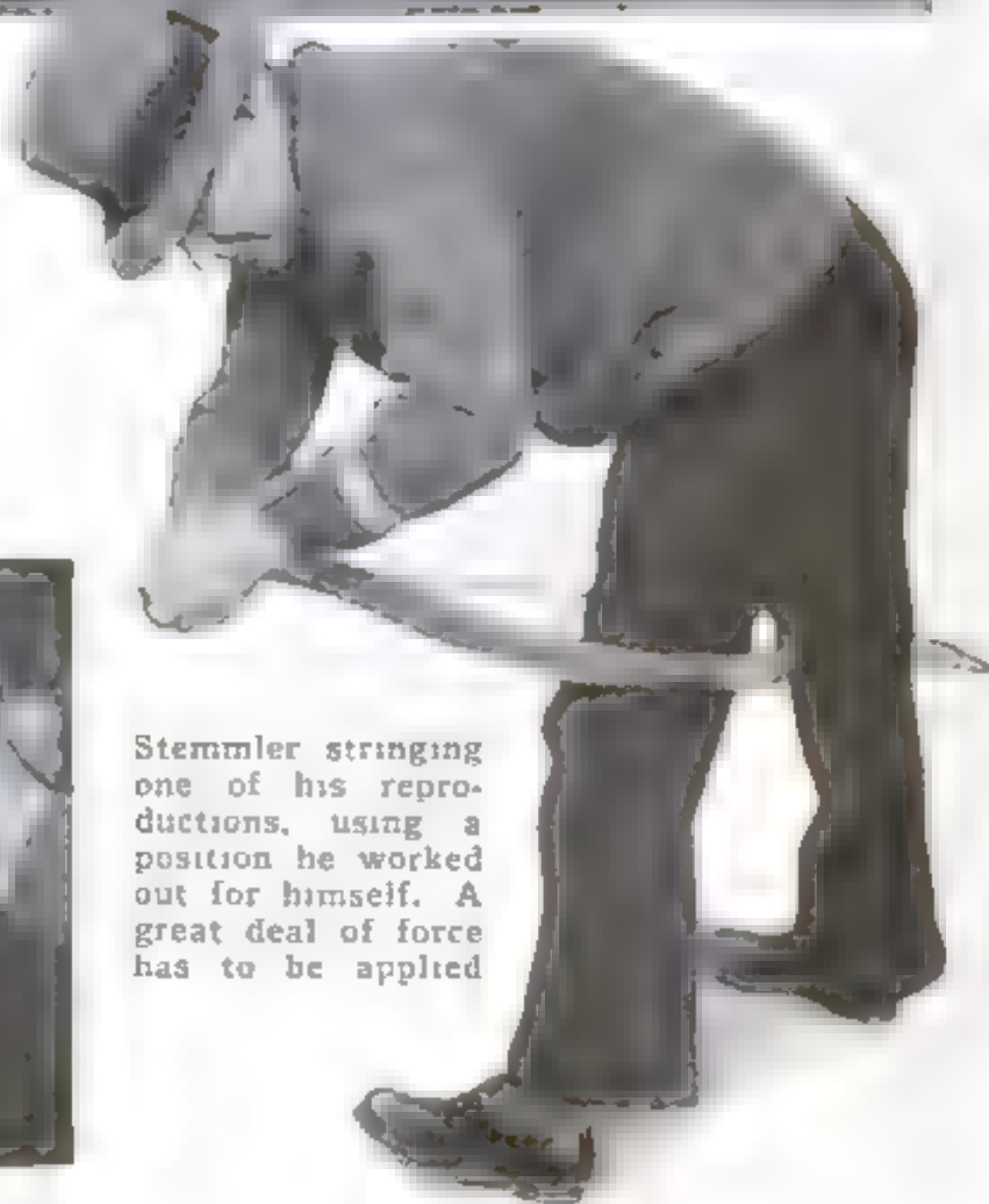
Successive stages in the making of a Turkish composite bow, with the finished bow shown at bottom



A wooden form with the core of the bow bound to it for shaping the laminated strips. At the right, animal sinew clamped in a vise is being torn into shreds which will be matted with glue to form a backing for the wood core



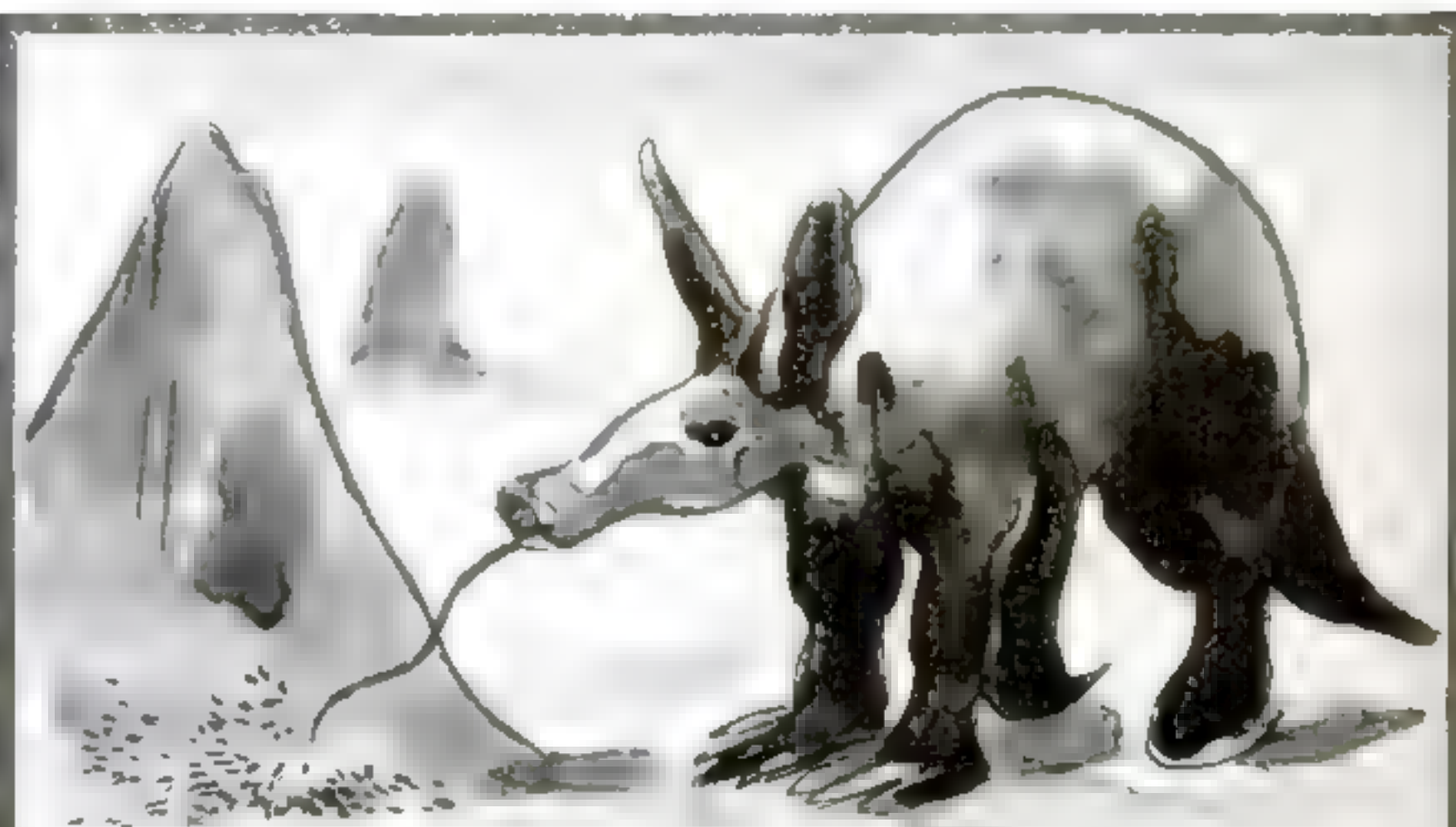
Stemmler stringing one of his reproductions, using a position he worked out for himself. A great deal of force has to be applied



Un-Natural History By GUS MAGER



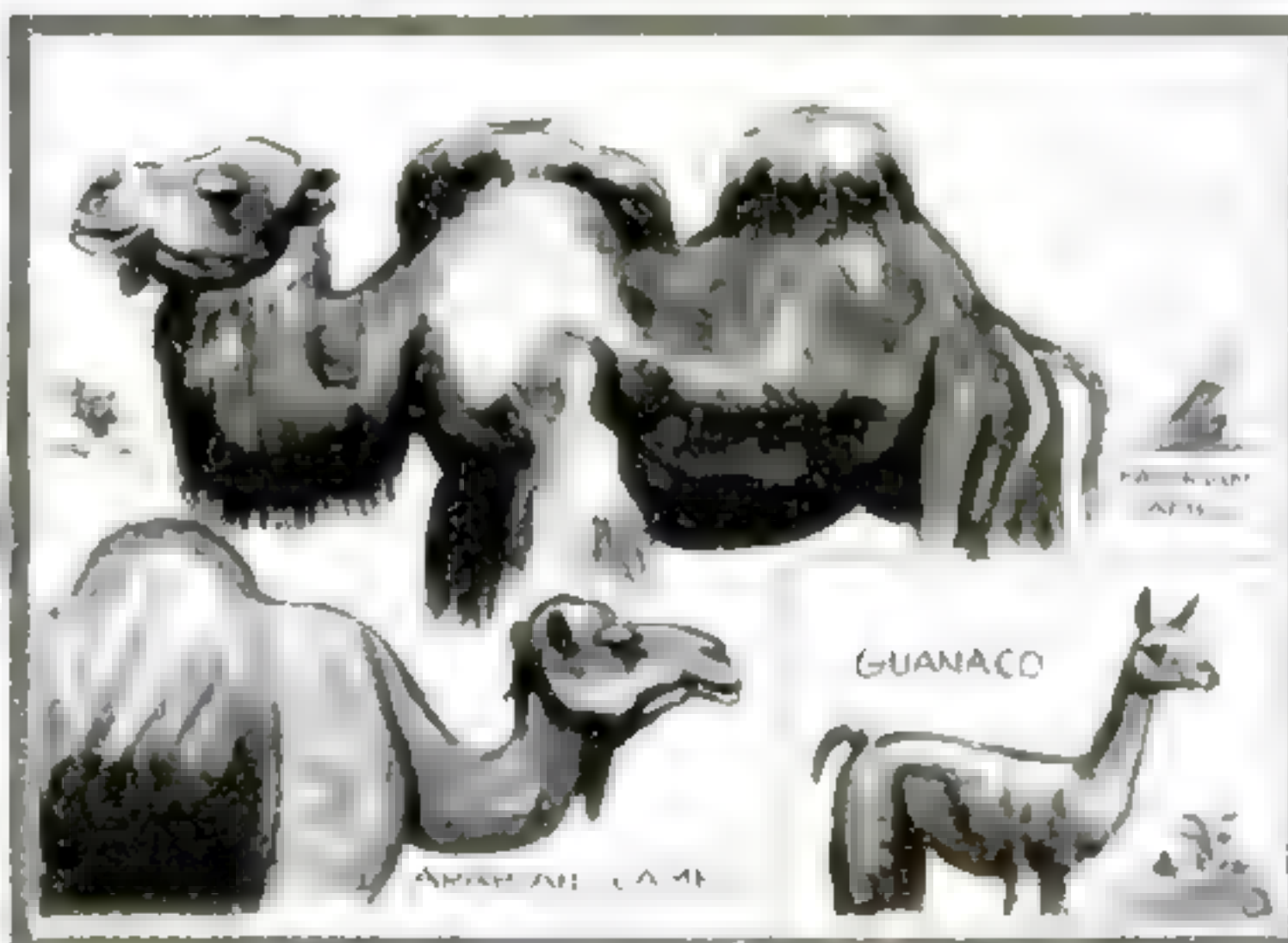
MORNING-GLORIES OPEN THEIR BLOSSOMS ONLY IN THE MORNING, BECAUSE AT THAT TIME OF DAY THE DEW KEEPS ANTS FROM STEALING THE NECTAR. THE SWEET LIQUID IS RESERVED FOR BEES, WHOSE FUZZY HEADS WILL CARRY POLLEN FROM FLOWER TO FLOWER!



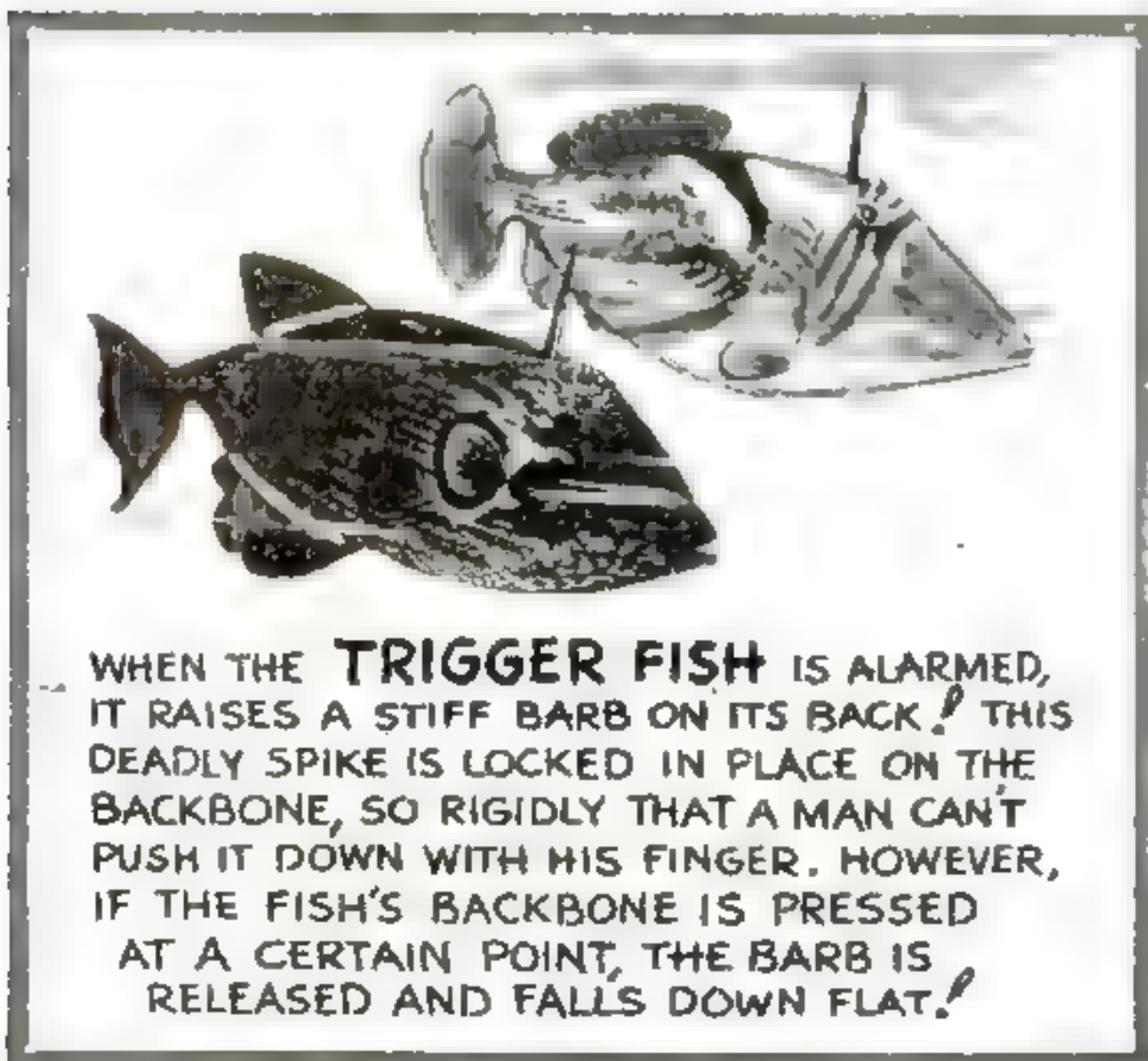
WHILE MOST TRUE ANTEATERS ARE AS TOOTHLESS AS THE PROVERBIAL HEN, THE **AARD-VARK**, OR **AFRICAN ANT BEAR** HAS AT LEAST BACK TEETH! HE ALSO SHOWS HIS INDIVIDUALITY BY WALKING ON THE TOES OF HIS HIND FEET AND THE SOLES OF HIS FOREFEET, REVERSING THE PROCEDURE FOLLOWED BY THE **TAMANDUA ANTEATER** OF CENTRAL AND SOUTH AMERICA!



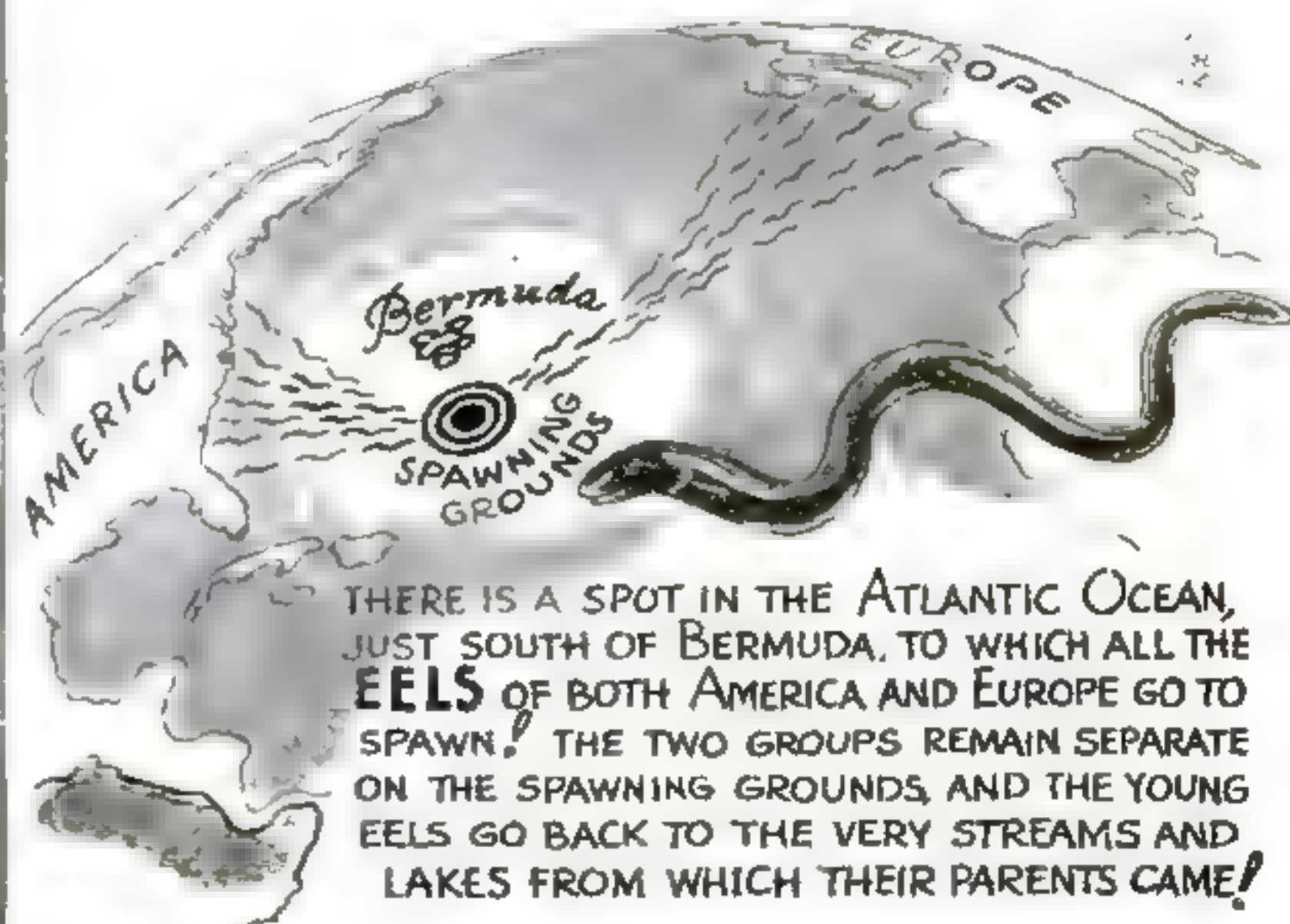
CHAMPION SLEEPER OF THE BIRD KINGDOM IS THE **FROGMOUTH** OF MALAY AND AUSTRALIA. IT IS SAID TO SLEEP SO SOUNDLY DURING THE DAYTIME THAT IT CAN BE LIFTED WITHOUT AWAKENING!



CAMELS ONCE ROAMED THE PLAINS OF NORTH AMERICA! IN A NEBRASKA FOSSIL BED HAVE BEEN FOUND THE BONES OF HUNDREDS OF CAMEL-LIKE ANIMALS SIMILAR TO THE **GUANACO** OF SOUTH AMERICA YET WHEN AN EFFORT WAS MADE TO REINTRODUCE THE CAMEL ON THE PLAINS OF THE SOUTHWEST IN 1856, ALL THE ANIMALS PERISHED!



WHEN THE **TRIGGER FISH** IS ALARMED, IT RAISES A STIFF BARB ON ITS BACK! THIS DEADLY SPIKE IS LOCKED IN PLACE ON THE BACKBONE, SO RIGIDLY THAT A MAN CAN'T PUSH IT DOWN WITH HIS FINGER. HOWEVER, IF THE FISH'S BACKBONE IS PRESSED AT A CERTAIN POINT, THE BARB IS RELEASED AND FALLS DOWN FLAT!



THERE IS A SPOT IN THE ATLANTIC OCEAN, JUST SOUTH OF BERMUDA, TO WHICH ALL THE **EELS** OF BOTH AMERICA AND EUROPE GO TO SPAWN! THE TWO GROUPS REMAIN SEPARATE ON THE SPAWNING GROUNDS, AND THE YOUNG EELS GO BACK TO THE VERY STREAMS AND LAKES FROM WHICH THEIR PARENTS CAME!

New Devices for the HOUSEHOLD



MUSICAL REFRIGERATOR. A radio receiver built into the top of a new refrigerator enables the housewife to tune in on music or recipes in the kitchen

LIQUID CONTAINER
TURNS ON BALL
BEARINGS



SPRING-OPERATED
RAM PUSHES ICE
UP INTO OUTER SHELL



BEVERAGE COOLER. When the two-walled outer shell of this ingenious accessory is filled with ice, as shown at the right, and the base is screwed on, a spring-operated ram forces the lumps against the upper wall, while water formed by melting drips into the base. The inner cup, which fits snugly inside the shell, rides on ball bearings so it can be rotated to promote cooling. The top has a pouring spout



CLEANS BLINDS

Venetian blinds are easily dusted with a new tool that consists of a coiled metal spring covered with soft cloth and fastened to a metal handle. When soiled, it can be cleaned readily with soap and water



VERSATILE FAN

Mounted on a special base that will stand on a table, clamp to the head of a bed, or hang from a hook on a wall, the handy rubber-bladed electric fan illustrated can be used almost anywhere it is desired



COFFEE DISPENSER

Spinning a telephone-type dial on this wall fixture measures out ground coffee without exposing the supply to the air. The user inserts a finger in the proper hole for the degree of strength desired, and spins once for each cup





STORAGE TANK FOR BOILING WATER. Water is kept boiling, or at any other temperature desired, by regulating a gas flame under the storage tank illustrated above. An indicator is set for the temperature desired, and the flame is controlled automatically. In this way, boiling water can be kept available in the kitchen at all times

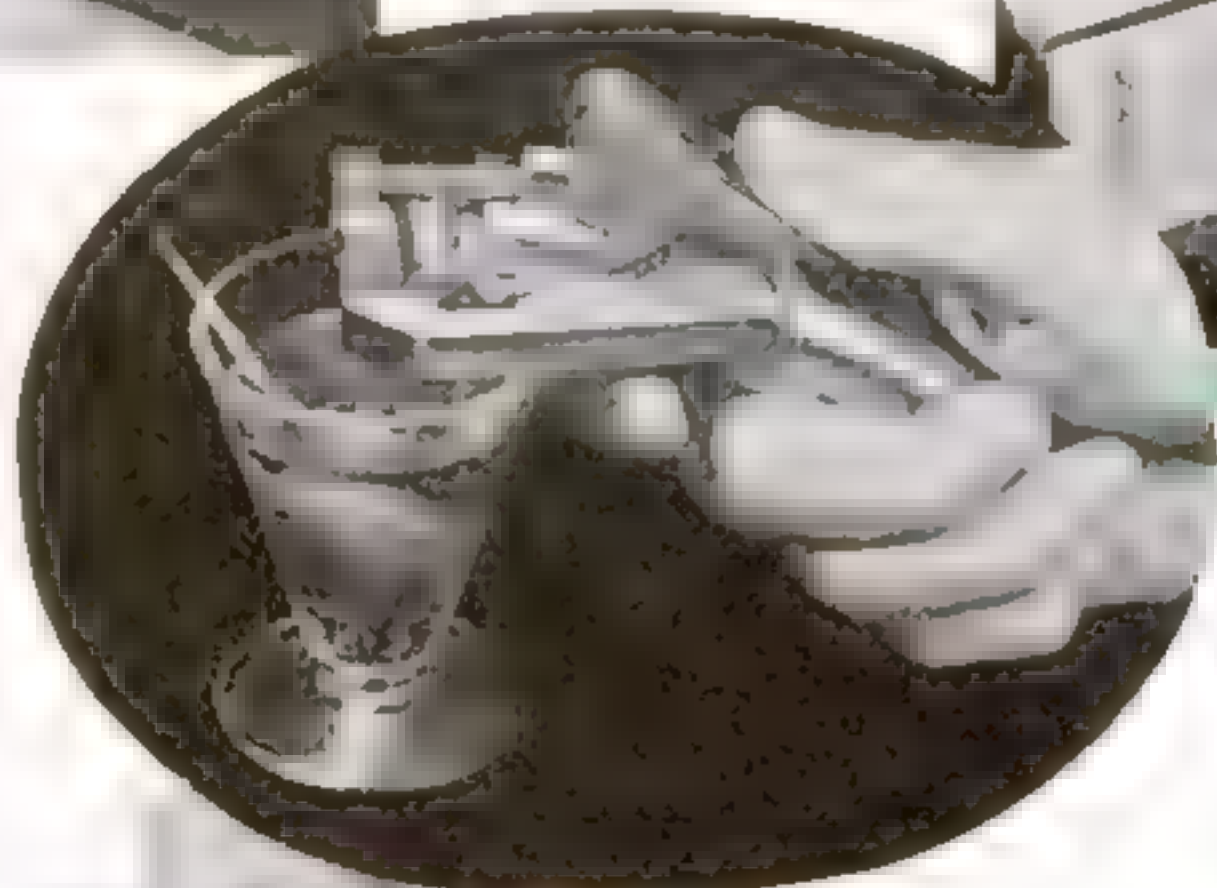
KIT FOR MAKING CANDY SUCKERS

With molds and supplies furnished in a new outfit, professional-looking candy suckers can be manufactured in the home. Materials include the molds, coloring and flavoring solutions, sticks, and wrappers

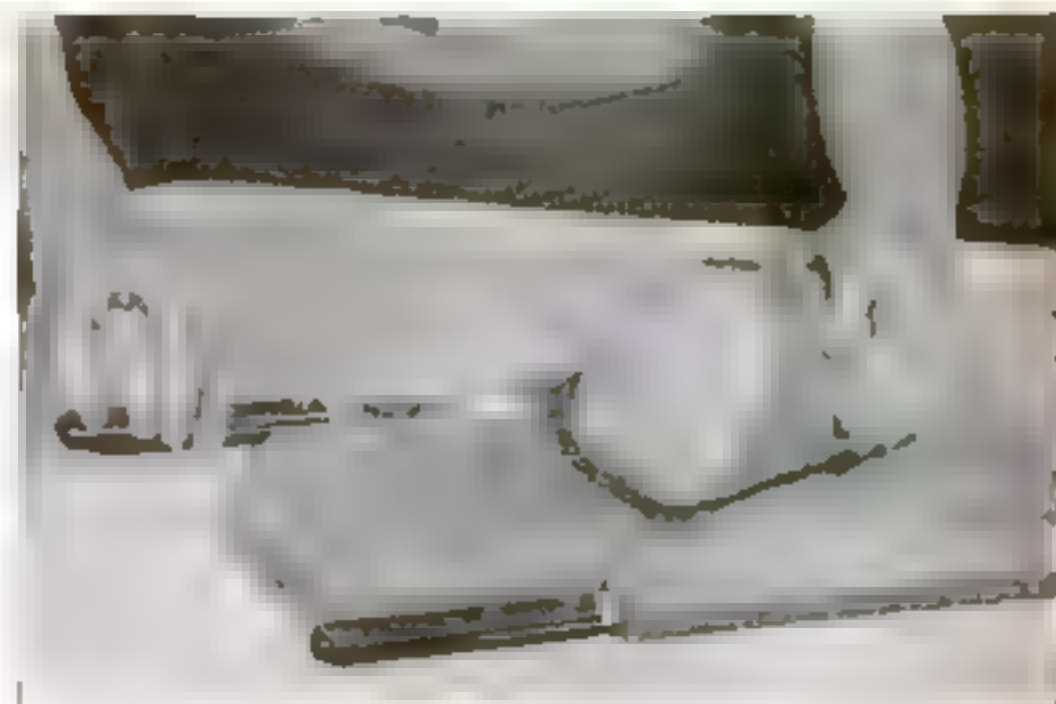


EXTRACTS OIL FROM FRUIT RIND

To improve the flavor of fruit drinks, the device pictured below squeezes oil from the skins of oranges and lemons directly into the glass. It operates by pulling a trigger



PORTABLE ICE BOX For serving cold beverages in the living room or on the lawn, the novel ice box shown at the left is fitted with rollers and convenient trays. It holds fifty pounds of ice and has ample bottle space



CUTTING BOARD HOLDS KNIVES. Holders attached to the sides of this cutting board keep knives where they can be found when needed



MODELS AID KITCHEN PLANNING. To help housewives plan the arrangement of their kitchens, salesmen for electrical appliances use midget fixtures which can be moved about between boards spaced to the proportions of the room

ART DESIGNING

This Article Tells You How You Can Capture The Elusive Beauty of Tiny Objects Seen Through Your Magic Lenses, Employing Them As Models for Novel, Striking Decorations

By MORTON C. WALLING



PATTERNS FOR DRESS GOODS

Designs printed on dress goods often are inspired by microscopic objects such as the potato-starch grains shown at left as seen under polarized light

you discover a promising subject, it is a simple matter to make a drawing of it on a piece of paper. From this basic pattern, you can develop the required design, just as you can employ a drawing of a tulip as the basis for a decorative motif.

When the microscope is coupled with a camera, the possibilities of making use of its designing abilities become even greater. There are hundreds of ways in which you might employ photomicrographs in decoration.

Suppose, for instance, that you have the job of finding an unusual background

design for use in a booklet, a party invitation, or some other place where the design will form a foundation for lettering and pictures. Get out your collection of slides and examine them for possibilities.

For instance, consider a group of slides showing cross sections of woods—white pine, walnut, mahogany, oak. Enlarged to a hundred diameters, the network of cells and ducts forms a pattern as beautiful as that of fine lace. The same holds true of slides containing groups of hairs and textile fibers in cross section. Most people probably would not recognize these things if they saw them in the form of photographs or reproductions, but the patterns are interesting enough to enable

them to stand out on their own merits.

Have you ever been fascinated with those patterns that seem to change their shape or perspective while you look at them? The microscope can produce them, too. Obtain an oyster shell or some other shell that has a mother-of-pearl lining. Wash the pearly surface (nacre) thoroughly, and drop on it some liquid collodion, which you can get at the drug store; or you can dissolve some celluloid in acetone to produce a similar material. Spread the collodion out in a thin layer and let it dry. Then strip the film carefully from the shell and mount it on a slide.

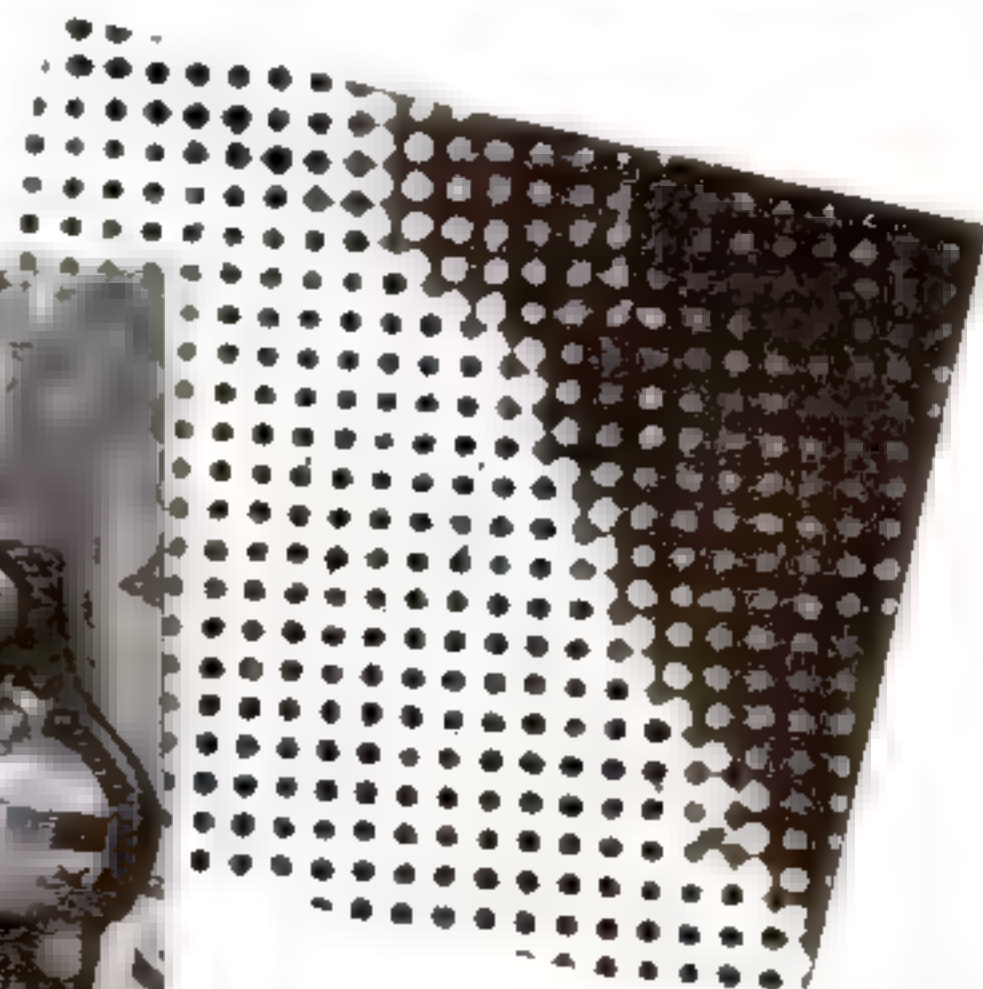
When you examine it with your microscope, you will find that the collodion has received the impression of the tiny ridges or folds that produce the beautiful iridescence of pearl. Make a photomicrograph of the film, adjusting the light carefully to bring out the folds. Gaze at the print steadily and, if the lighting is correct, you will be surprised to see the pattern suddenly flop into reverse. In a similar way you can make a reversible picture of the outer surfaces of mussel and other shells that are made up of little hexagonal blocks of limestone.

A design suitable for many background uses consists merely of a network of lines, something like chicken wire. Again, the sea shell can help you. Select a mussel or similar shell, and break a piece from it. Soak this in weak muriatic (hydrochloric) acid until bubbles cease to rise from it. This dissolves out the lime deposit, leaving the membranous partitions between cells. Properly focused by the microscope,

IN YOUR explorations of the wonders of the microscopic world, you must have paused often to marvel at the sheer beauty of some pattern disclosed by your magic lenses. It may have been the symmetrical cell structure in a cross section of a woody plant stem, the fantastic outlines of some tiny animal, or the geometric perfection of crystals. Have you ever thought that these miniature art works of nature might be magnified to serve as decorations, lending their beauty to practical objects that we use?

As a matter of fact, artists who design such things as printed dress goods and wall paper frequently are influenced by the beautiful patterns that can be seen only with the microscope. Browse through the dry-goods section of a department store, and you probably will come across some percale or other printed material that is covered with modified diatoms. The wall-paper department will make you suspect that some of the artists have been looking at crystal patterns or other objects through a microscope.

The microscope can serve as a designer in various ways. If you have occasion to work out an unusual pattern for a wall decoration, book cover, table top, or anything else upon which you want to leave the stamp of originality, it will pay you to spend a little time looking at random objects through your microscope. When



Make a photomicrograph of one of the photographs on this page, using the simple set-up pictured at the left, and you will get an arrangement of dots suitable for decoration

with Your MICROSCOPE

this network forms an attractive pattern that can be shown in a photomicrograph.

If you do not wish to use the picture as it is, trace over the principal lines with India ink, and then bleach out the image. A suitable bleach consists of a solution made by diluting tincture of iodine with about six parts water. Soak the print in it until the image has turned uniformly brown, or disappeared entirely. Then remove the iodine and the remaining traces of the image by immersing the print in ordinary hypo fixing bath. Wash and dry.

Perhaps your decorative problem consists of working out an attractive and unusual border for a picture, for a band across the cover of a book or folder. A photomicrograph of one of the algae, such as Spirogyra, may serve your purpose. The orderly row of cells, each almost exactly like the other, produces the desired border effect.

Another way of developing an interesting border is to arrange a series of images. Thus you can make an attractive design by printing or drawing a number of pictures of a diatom, and arranging them side by side. Likewise, the images can be arranged to form a star-shaped pattern, or almost any other shape you desire.

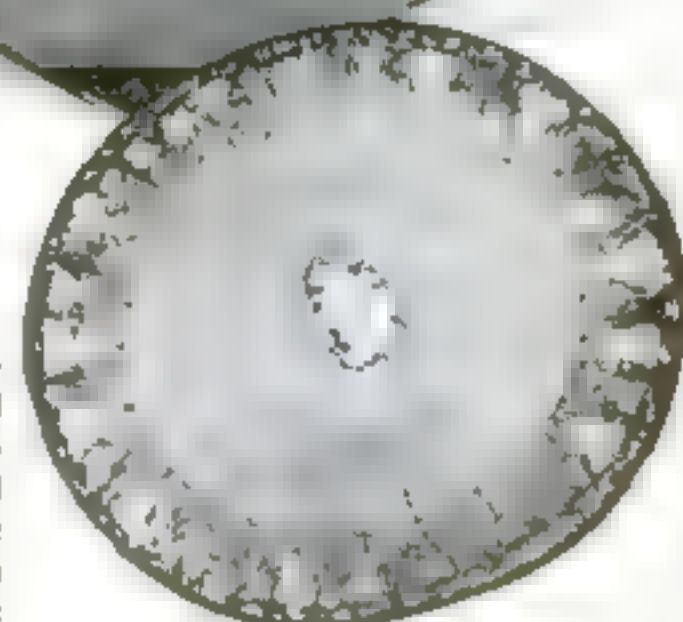
Diatoms alone offer almost endless possibilities. Designers have used them as



inspiration for a great variety of patterns. Many diatoms are in themselves so beautiful in form that no human artist can improve upon them. Makers of diatom slides sometimes arrange the tiny bits of glasslike silica in attractive patterns. Pho- (Continued on page 117)

MOTHER NATURE AS DESIGNER

A cross section of bass-wood stem, photographed under the microscope, enlarged, and traced in red ink, makes an attractive cover design for use on a notebook or scrapbook



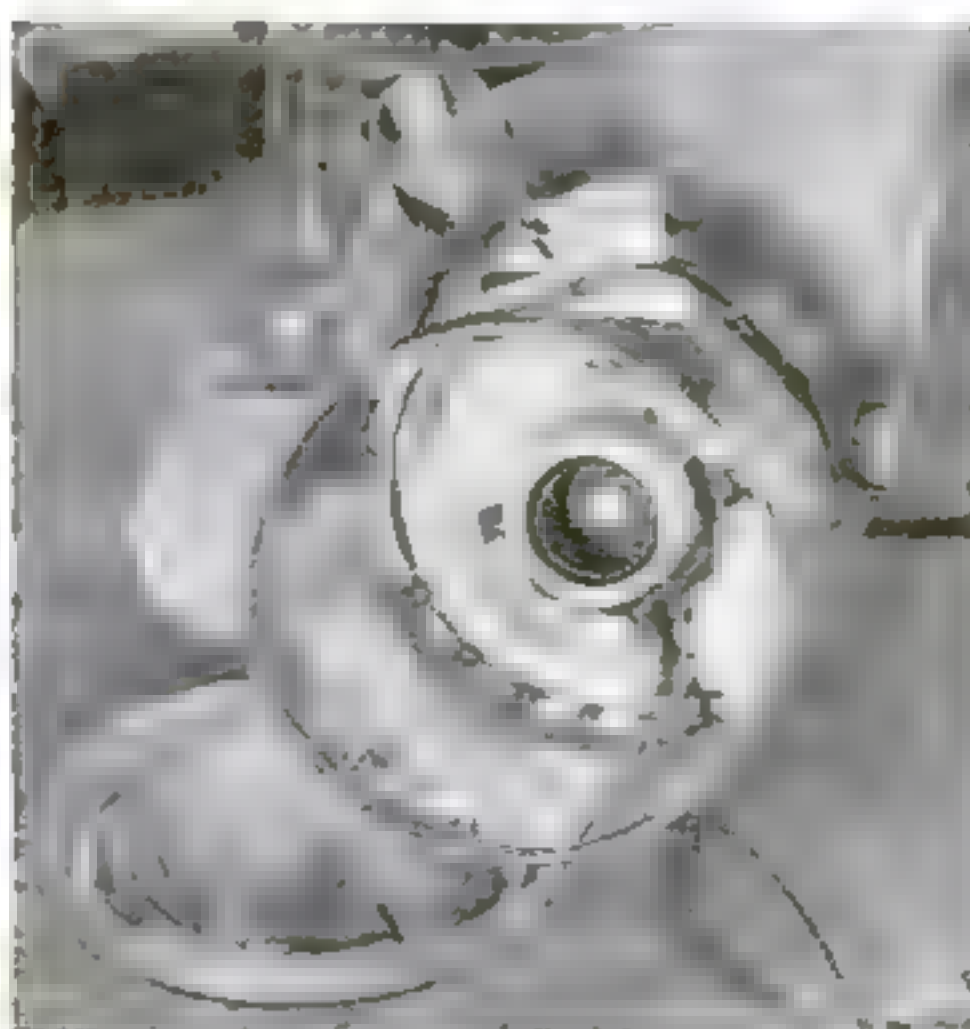
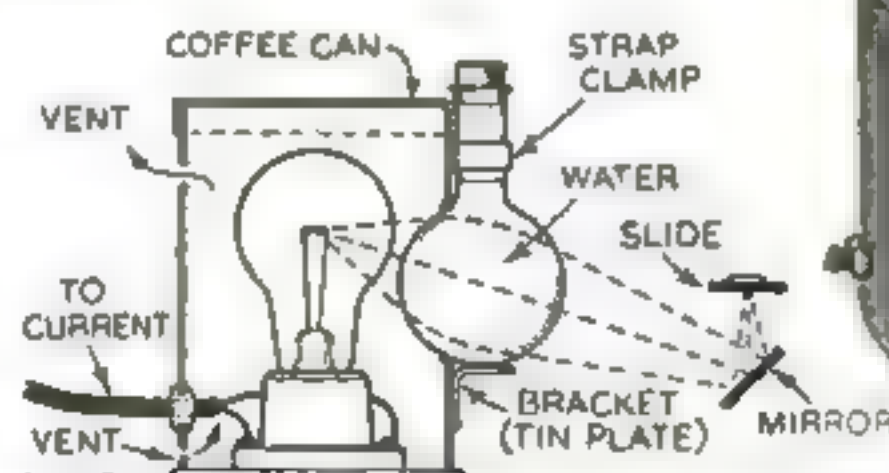
Lamp Made from Tin Can Gives Cool, Concentrated Light

WITH the simple tin-can lamp illustrated, you can give your microscope slides illumination that is concentrated in a relatively small spot, and from which the heat rays have been removed.

Mount a porcelain lamp socket in the bottom of an empty coffee can, running the wires through a hole. In one side of the can, cut a hole just large enough to accommodate the bulbous part of a round-bottom laboratory flask of 200 or 250-cubic-centimeter size, placing the center of the hole a little lower than the filament of a twenty-five or forty-watt lamp screwed into the socket. A few holes punched in the side of the can opposite the flask opening will serve as ventilators.

When the lamp is to be used, fill the

flask with water and cork it with a wad of cotton or a stopper with a hole in it to permit expansion of the liquid. Copper sulphate added to the water will make the illumination more like daylight, and the flask also can be used for holding liquid filters.



HOW THE TIN-CAN LAMP IS BUILT

A glass flask, mounted in an opening in the lamp housing and filled with water or a colored solution, cools and concentrates the light coming from the bulb set inside. The photographs show how the coffee can is cut, the lamp socket mounted in it, and the flask being filled with liquid. The drawing illustrates the set-up of the outfit and the way it operates

What's It

HOW TO ANALYZE



By
RAYMOND B. WAILES

TESTING household products offers a fascinating and practical diversion for an amateur chemist. Simple experiments, well within the natural limitations of a home laboratory, will yield a surprising amount of information about such preparations as ammonia, medicines, tooth powder, cosmetics, tobacco, and a variety of others.

When you purchase a bottle of household ammonia, you actually are getting a solution of ammonia gas in water. In case two brands are similarly priced, the one containing the most ammonia is, presumably, the best buy. You can easily find out for yourself which is the stronger by "titrating" them with dilute sulphuric acid.

Place exactly equal amounts of the two brands of ammonia in separate test tubes—about ten cubic centimeters, or three teaspoonfuls, will do—and add to each test tube a drop or two of methyl orange indicator. Then add weak sulphuric acid, drop by drop, to one of the test tubes until the color of the solution changes from orange to red. Note the quantity of acid used. Repeat the test with the contents of the other tube. The ammonia that requires the most acid to effect the change is the stronger. If you add the acid from a graduated tube or burette, the exact amounts used may easily be compared. Acid of suitable strength for this test can be made by diluting three cubic centimeters of strong sulphuric acid with water, to a total volume of 100 cubic centimeters (a drinking glass contains about 240 cubic centimeters).

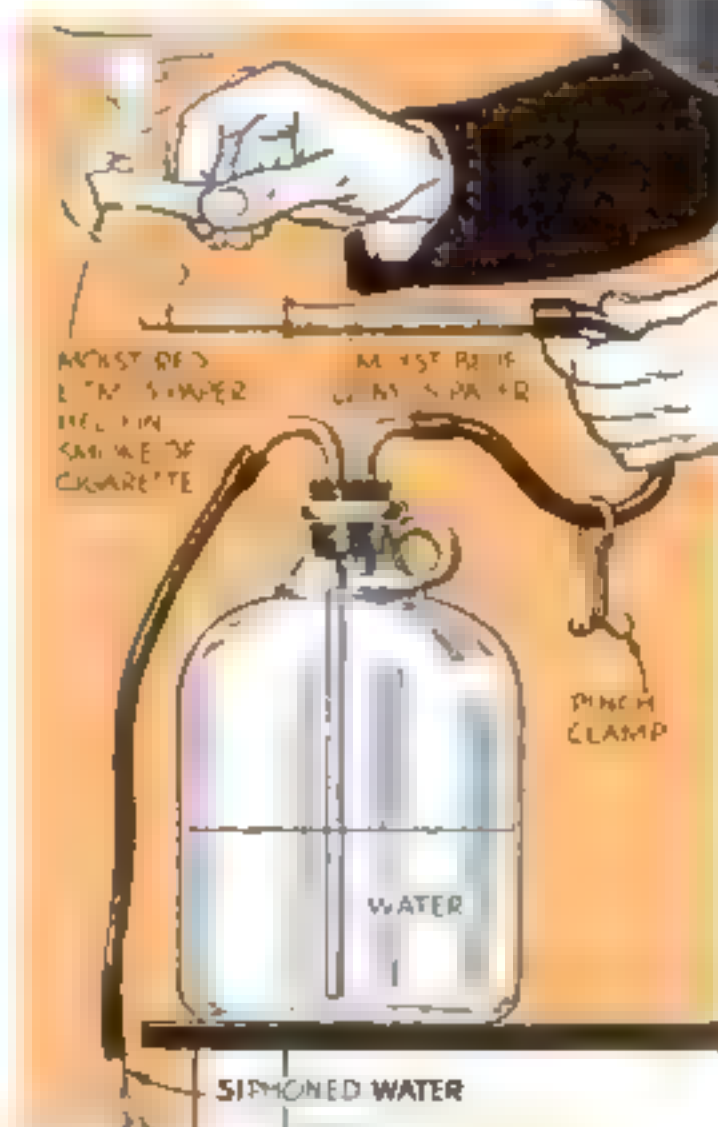
Drug-store remedies for indigestion usually consist of baking soda (sodium bicarbonate) combined with various other

The amateur testing laboratory in operation. At the right, a wad of cotton wet with hydrochloric acid is being held above some tobacco and lye water in a beaker to prove that nicotine is present

materials. Many of the brands contain some form of bismuth, and the presence of this comparatively high-priced ingredient can be detected by a simple but interesting test.

If the product is a powder, try heating some of it in a test tube with a mixture of powdered potassium iodide crystals and flowers of sulphur. If it contains bismuth, the resulting chemical reaction will release the vapor of bismuth iodide, which will condense as a scarlet solid on the inside wall of the test tube. This "sublimate" can best be identified with the aid of a magnifying glass, after the tube has cooled and the brown drops of distilled sulphur have turned yellow, as otherwise the sulphur may be mistaken for the scarlet bismuth iodide. To test a liquid preparation for bismuth, heat it in an evaporating dish until nothing but solid material remains, and proceed as before.

Many tooth powders contain sodium perborate, which releases oxygen gas when it is moistened. One way to detect it is



MECHANICAL SMOKER. This simple apparatus will "smoke" a cigarette while you analyze the chemical products in the fumes

to test the tooth powder for boron, an element present in the perborate compound, which has the characteristic of turning a flame green.

Place some of the tooth powder in a test tube that has a side arm as shown in one of the photographs. Add enough strong sulphuric acid to cover the powder, and then an equal amount of grain or rubbing alcohol. Connect the side arm of the test tube, instead of the regular gas supply, to the gas inlet of a Bunsen burner and heat the contents of the test tube. You will find that you can light the gas issuing at the top of the burner, and the resulting flame will be colored green through the formation of a compound known

as ethyl borate ester, if the tooth powder contains sodium perborate.

Oxygen released by a tooth powder of this type comes from the decomposition of the hydrogen peroxide that is formed through the interaction of sodium perborate and water. This provides another test for the tooth powder. If hydrogen peroxide is formed when it is moistened, it must contain the perborate compound.

You can test for hydrogen peroxide with an easily prepared solution made by dissolving five grams (about a teaspoon-

Made Of?

HOUSEHOLD PRODUCTS IN YOUR OWN LABORATORY

ful) of ammonium molybdate crystals in fifty cubic centimeters of water and then adding fifty cubic centimeters of strong sulphuric acid. Several drops of this reagent, added to a solution obtained by stirring some of the tooth powder in a little water, will show up any hydrogen peroxide by turning the liquid yellow. You can make sure your reagent is working properly by trying it out in another test tube containing several drops of drug-store peroxide.

A variation of the preparation just described also can be used to test for the peroxide. Add a teaspoonful of a ten-percent ammonium molybdate solution to the liquid under test, followed by several drops of a dilute solution of citric acid. Again, a yellow color develops if hydrogen peroxide is present.

Add a few drops of salt water to a solution of silver nitrate, and you will observe a precipitate of silver chloride. The white precipitate will turn gray and then black when exposed to the light. Similarly, if you add several drops of a solution of sodium chloride, or table salt, to the liquid contained in the brown glass bottle furnished with many hair-dye "sets" or colors, a white precipitate will form. It turns grayish-black when exposed to the light, indicating that the amber bottle contains a soluble silver salt. In most hair dyes, this salt is silver nitrate.

A powder accompanies the hair dye. The instructions direct the buyer to dissolve this in water and apply it to the hair following the use of the silver nitrate solution. Try adding an acid, such as sulphuric acid, to the powder, and acrid

sulphur dioxide gas will be liberated. If you treat a solution of the powder with several cubic centimeters of silver nitrate solution, you will obtain a brown precipitate that slowly turns dark. This silver precipitate is the agent that colors or dyes the hair. Reactions like those you have just observed indicate that the powder is a thiosulphate.

Some freckle-removing creams contain ammoniated mercury, which may prove harmful to the skin. A simple way to test for mercury in such a cream is to heat several grams of it with a dilute solution of lye or other caustic, stirring meanwhile with a glass rod. Then immerse a strip or sheet of metallic aluminum, such as the metal-foil wrapping from a candy bar, in the liquid. The caustic reacts with the aluminum, giving off hydrogen gas. At the same time, any mercury in the solution will amalgamate with the aluminum. Remove the aluminum foil, wash it thoroughly with water, and set it aside without



Cigarette paper being reduced to ash to disclose the filler with which it may be "loaded." The crucible is supported on a nichrome-wire triangle



This test reveals the presence of sodium perborate in a tooth powder, which is heated in the test tube with sulphuric acid and alcohol

Handy Kit for Chemical Reagents

TO HOLD the small quantities of reagents used in "analytical" tests like these, you can make a neat and professional-looking little kit. Obtain a number of small bottles of uniform size, and fit them with medicine droppers, passed through holes in the stoppers. If the mouth of each bottle is small, you can simply slide a half-inch length of rubber tubing over the medicine dropper and use the dropper itself as the cork. A small wooden box of convenient dimensions keeps the bottles in order. Your kit may include "indicators" and other solutions that you frequently use about the laboratory, such as methyl orange,



Indicator solutions for analyzing household products are kept conveniently in small bottles with medicine droppers

phenolphthalein, sulphuric acid, sodium hydroxide, and silver nitrate. As silver nitrate is decomposed by light, keep this chemical in a brown-glass bottle, or in an ordinary bottle painted with black varnish.

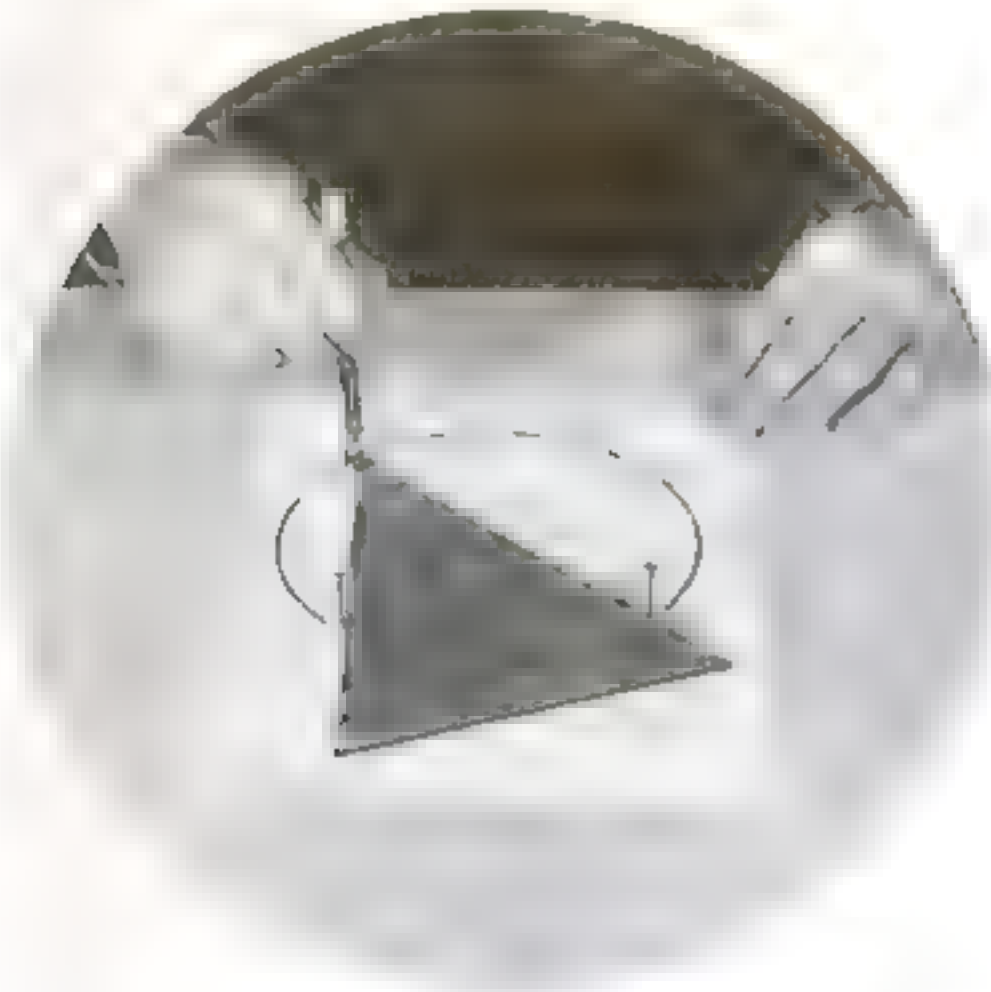
attempting to dry it. If mercury is present, the foil soon will emit crackling noises, and a fluffy white growth of alumina will appear upon its surface.

A modification of this test may be performed by heating together for a quarter of an hour a one-gram sample of the freckle cream, a strip of aluminum foil, a third of a teaspoonful each of five-percent sodium hydroxide solution and twenty-five-percent sodium thiosulphate solution. In this case, mercury is present if the growth of white alumina appears after the metal foil has been washed with alcohol or acetone.

Tobacco smoke, blown through a handkerchief, produces a brown stain—not of nicotine, as many suppose, but of vegetable tar distilled from the burning shreds. Extracting and testing for the nicotine itself is one of a number of interesting experiments you can perform with cigarettes, cigars, (*Continued on page 119*)

Test Reveals Your Eyes as a Range Finder

TO SEE how your eyes judge distances, place a pencil upright as shown at the right and hold a finger midway between the pencil and your eyes. When you look at the pencil you will see two fingers, and when you look at the finger you will see two pencils. The reason is that your eyes automatically turn inward just enough to make them receive the image of the object you are looking at in the same relative position, and other objects are seen double. Distance is judged by the amount the eyes must turn inward.

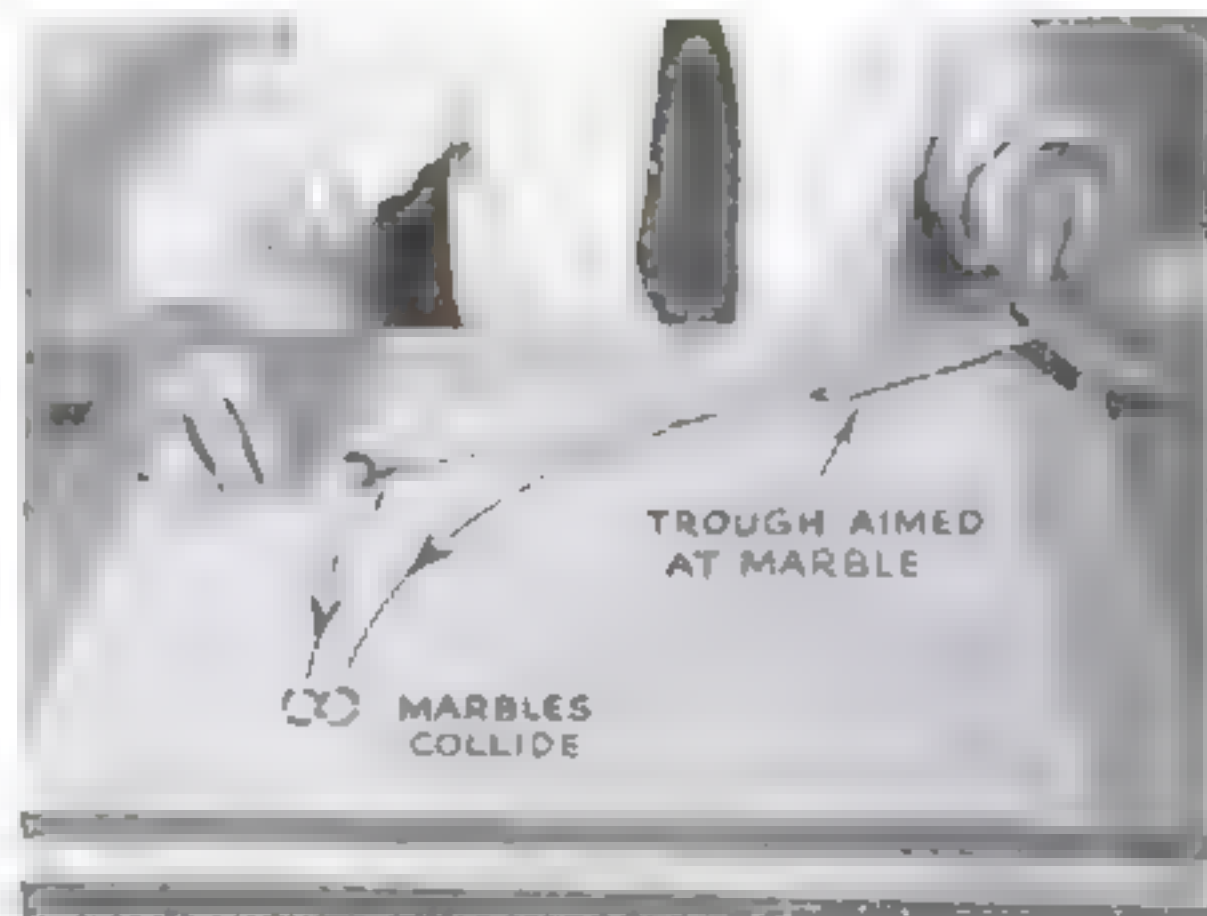


Laws of Science

SHOWN BY EASY HOME EXPERIMENTS

Angles Are Guides To Draw Circle

CUT a triangle from cardboard, with a pencil hole at one angle. By sliding the triangle against two nails, as above, you can make the pencil describe an arc of a circle. To complete the circle, use another angle equal to the difference between this one and 180 degrees. This stunt, based on a law of geometry, shows how straight lines alone can be used to develop a perfect arc.



If the marble held by the stick is released just as the other marble reaches the end of the trough, they collide

Marbles Illustrate How Bodies Fall

LAWS of falling bodies are illustrated surprisingly in this test. Tilt the top of a drawing board or table by raising one edge about an inch, and arrange a tin or cardboard trough to point directly at a marble held by a small stick as shown. Roll another marble down the trough and, just as it strikes the board, jerk away the stick to release the first marble. If the timing is correct, the two marbles will always collide, since gravity forces them both down the slope by the same amount, regardless of the fact that one has a sidewise motion.



Top Shows Principle of Electric Organ

WITH a pair of headphones and a piece of iron, you can demonstrate the principle of the electric organ. Make a hexagonal top from the iron and a stick of wood, and provide a small board with a hole in which the top will spin without "walking." Join the two tips of the headphone cord, and remove the cap and diaphragm from one of the phones. If you hold this phone near the spinning top, and listen with the other phone, you will hear a musical tone, the pitch of which changes as the top slows down. The tone is caused by the iron in the top cutting the magnetic field at the poles of the receiver.



Why Earth's Axis "Weaves"

THE strange contrast noted in the experiment illustrated above is due to the fact that in one case the top is supported at a point above its center of gravity, and in the other at a point below it. This phenomenon accounts for the "weaving," or slow change of direction of the earth's axis.

For the Radio Fan

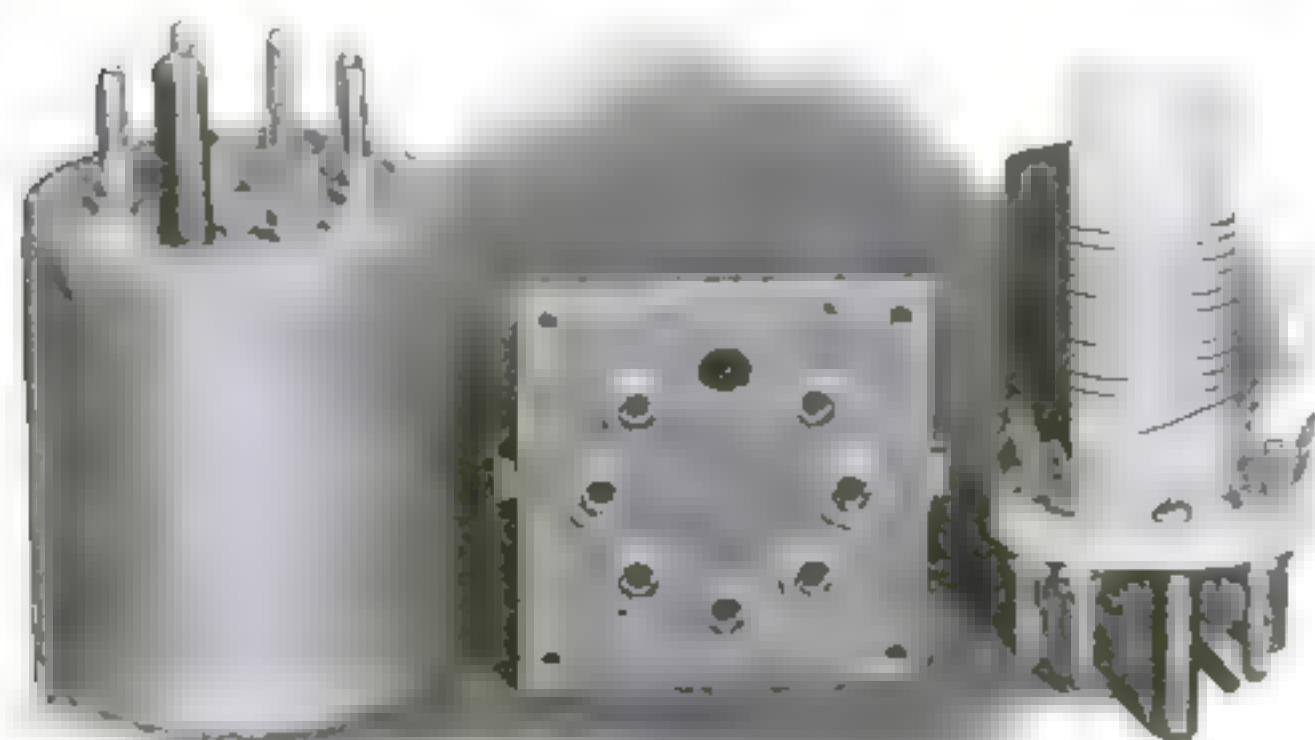


Pins Added to Pliers Aid In Forming Wire

IF YOU do any amount of set building or other electrical wiring, you will save time by equipping your pliers with the wire-forming pins illustrated above. Consisting of two short lengths of one-eighth-inch steel wire set in holes drilled close to the inner edges of the plier jaws, the pins make it easy to form the neat hooks and loops often required when making connections with stiff wire of the type used in transmitter circuits.

Coil Forms for Experimenters Simplify Wiring Changes

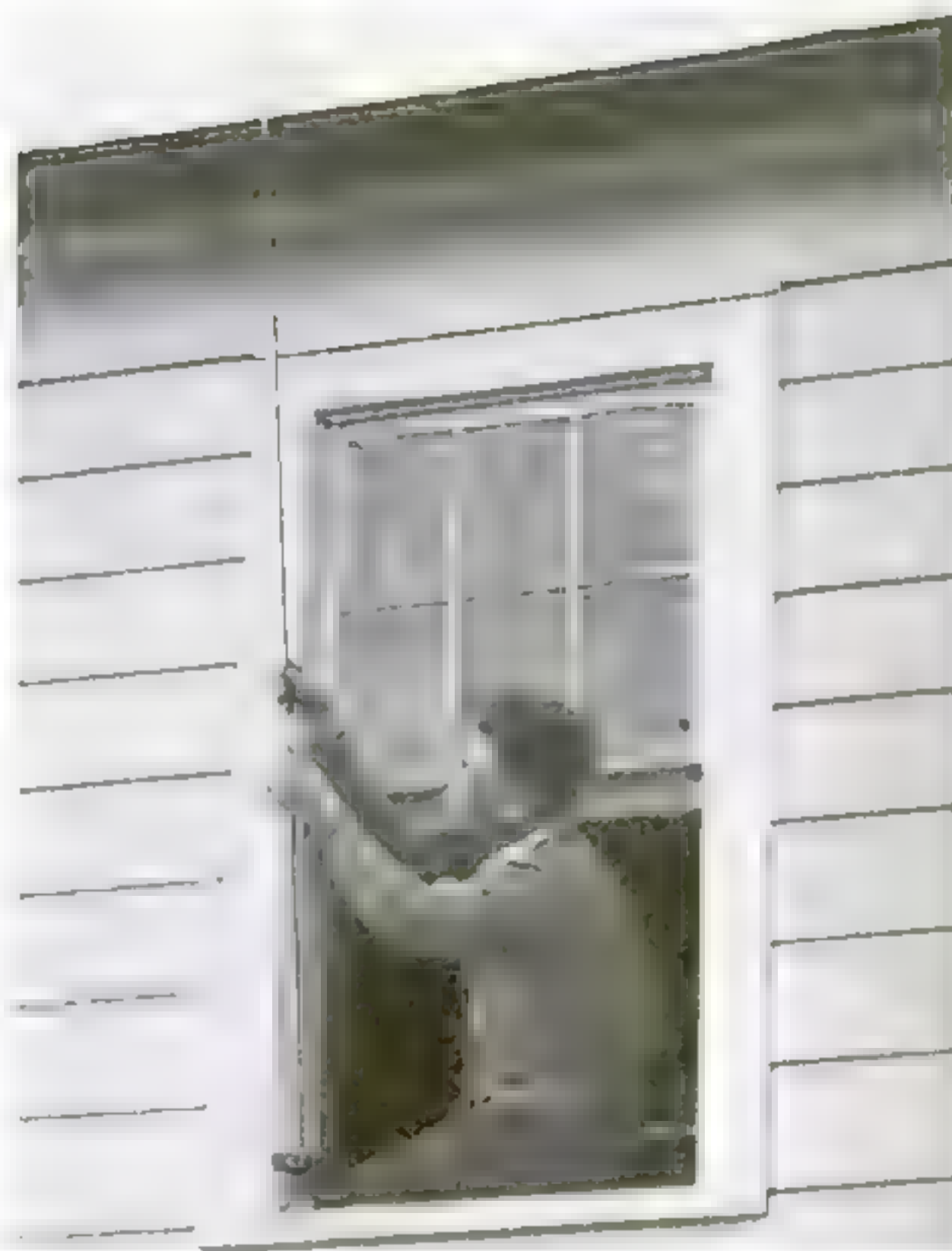
AN UNUSUALLY rugged and adaptable plug-in coil recently placed on the market is particularly suited to experimental and test work. The form, made of threaded insulating material, insures even spacing between the turns, while the base, fitted with seven banana-type plugs, not only provides ample connections for the most complicated multi-section windings, but has accessible soldering lugs that make it possible to connect experimental coils quickly and easily. The forms come complete with close-fitting aluminum shields and a special seven-hole socket. An insulated locating prong on each coil form fits into a hole in the socket to insure correct prong connections.



New coil form, socket, and coil with metal shield in place

Fish-Pole Antenna Fits on Window

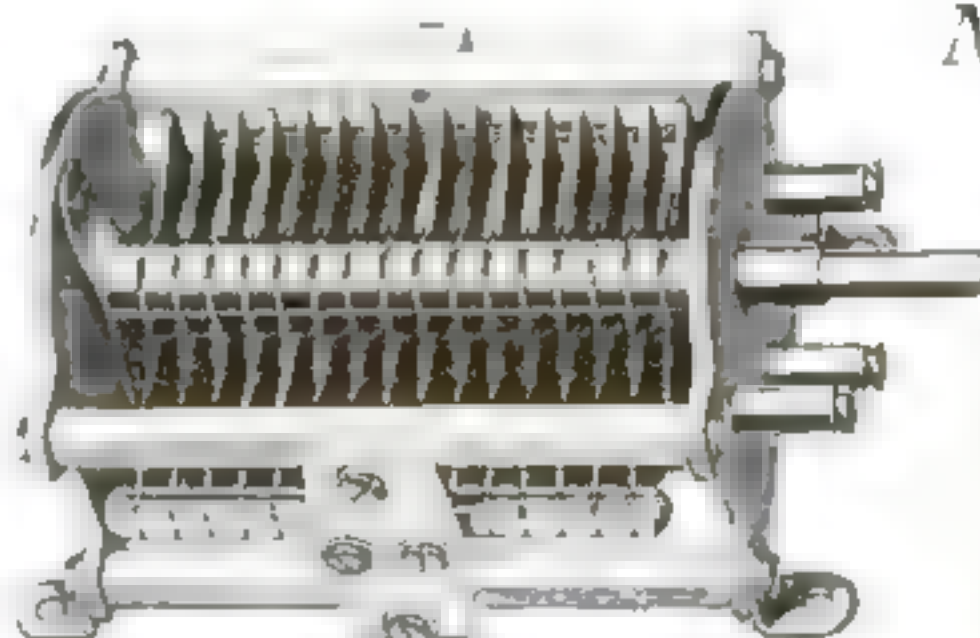
CONSTRUCTED like familiar rod antennas used on automobiles, a new telescoping fish-pole aerial designed for house use solves the problem of rigging outside wires in cramped quarters. Mounted on the side of the window frame by means of a convenient insulated screw clamp as shown in the photograph at the right, the slender, sectional pole can be extended to a length of eight feet. Made of steel, the antenna is extremely strong, will bend without breaking, and is rust-proofed. Connection to the receiver is made through a flat lead-in tape that fits under the window.



The antenna can be extended simply by adjusting the sections

New Low-Cost Condensers for Short-Wave Work

FOR THE amateur who experiments with a great many types of short-wave transmitter circuits and who necessarily wants to keep the cost down, an inexpensive condenser for medium and low-power hook-ups has recently been placed on the market. Available in sizes ranging from 20 to 530 mmf., the units are designed for either panel or base mounting.



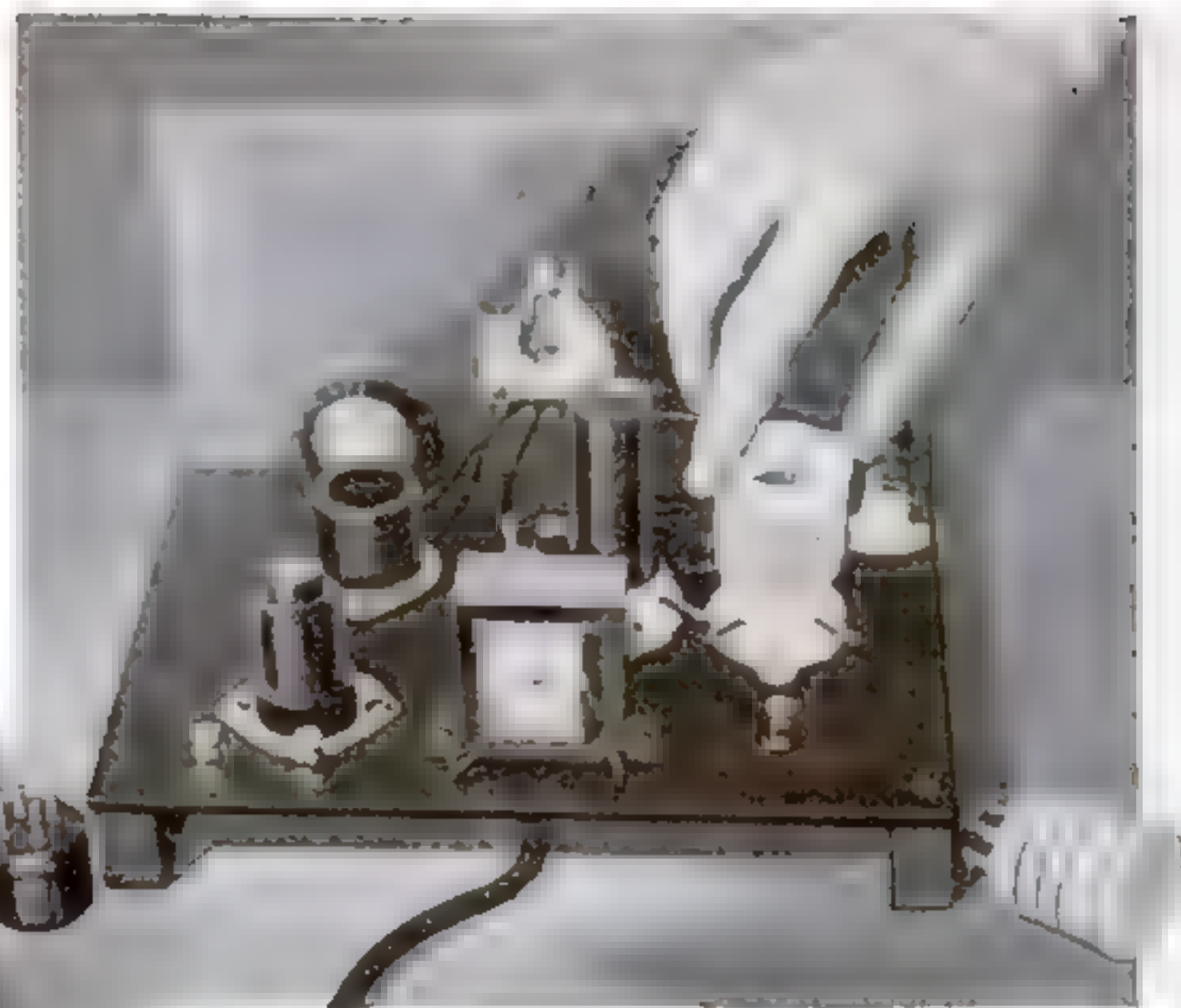
Pencil Has Built-In Resistor Color Guide

BESIDES serving as an automatic pencil, the combination unit shown at the right provides a handy resistor color guide and a short insulated screw driver for making receiver adjustments. When three colored bands on the body of the pencil are rotated until they correspond with the colors of the body, tip, and dot on an unknown resistor, the resistance value can be read directly from the scales eliminating the necessity of memorizing the standard color code or carrying a complicated table. Pulling out the top of the pencil reveals the short insulated screw driver.



An insulated screw driver, above, as well as the color guide for resistors shown at the top, is provided by this convenient automatic pencil

This set can be used to bring in commercial, television, police, and amateur stations that operate on wave lengths all the way down to four meters



Six coils, four for the regenerative part of the circuit and two for the superregenerative hook-up, provide for changing the bands. All the coils are easily wound

Homemade Short-Wave Set

ACTUALLY two receivers in one, the novel two-tube circuit illustrated provides an extended range that covers the ultra-short-wave band as well as the regular short waves. Beginning where most receivers leave off, it not only provides reception on the fourteen to 200-meter bands, but can be used to bring in the police, commercial, television, and

amateur stations that operate on wave lengths as short as four meters.

Two all-metal tubes are used in a combination circuit in which two tubes do the work of three. A dual triode (6N7) serves as a twin detector—one triode section providing an ordinary regenerative detector for the regular short-wave bands, and the other serving as a superregenerative detector on the ultra-short waves. A single-pole, double-throw switch provides a convenient means of switching quickly from one to the other. Amplification is provided by a 6C5 tube.

It is the twin detector that provides the circuit with its extreme flexibility. Simply by snapping the switch, the outfit can be transformed from an efficient short-wave receiver into a highly sensitive ultra-short-wave set. In a split second, a listener can shift from a "ham" phone conversation on the ten-meter band to a Berlin orchestra broadcast by a twenty-five-meter station.

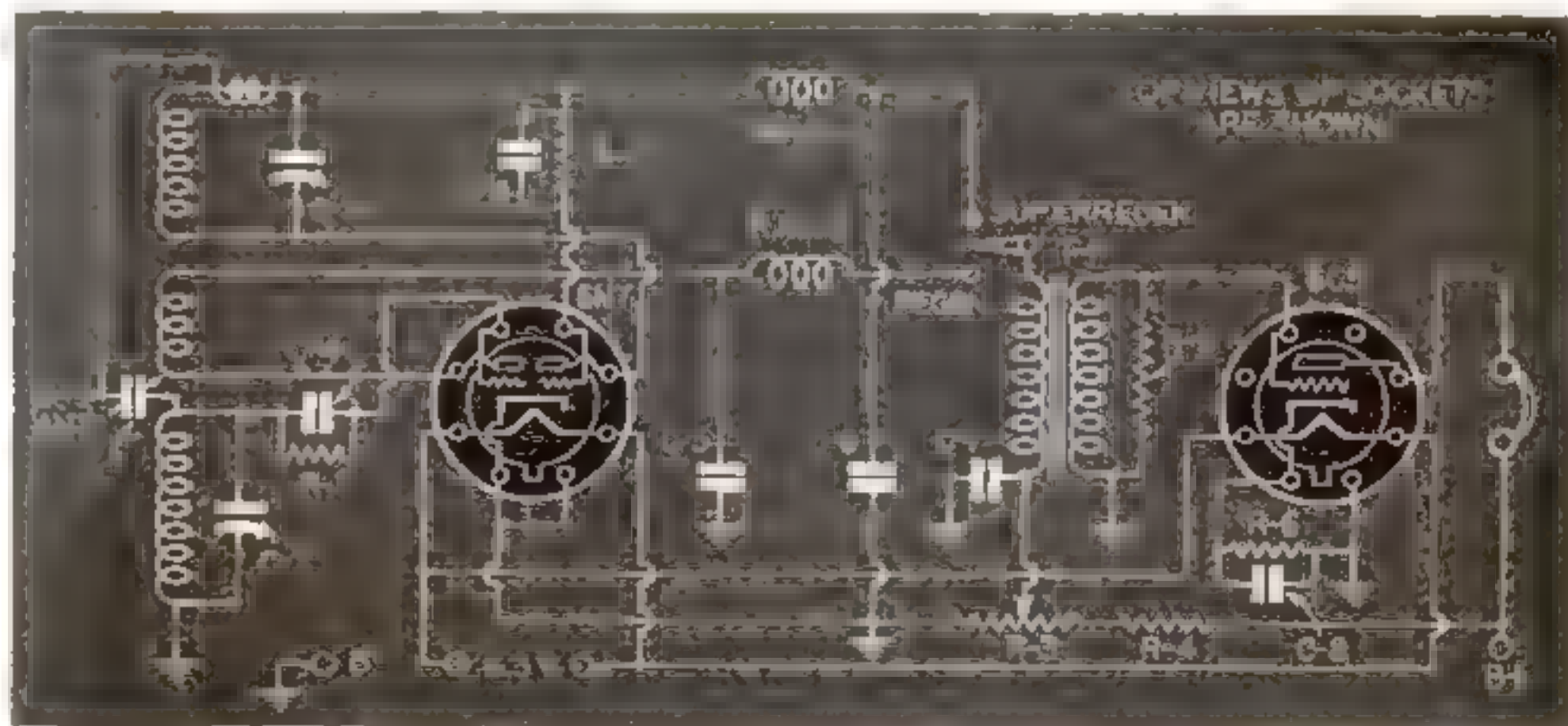
As shown in the photographs, the outfit is mounted on a seven by ten-inch alu-

minum panel and a seven by ten-inch chassis. To provide good insulation, the chassis is cut from a new composition insulating material sold in sheet form. Attractively finished in black crackle, it is strong, a good insulator, and extremely easy to work. It resembles pressed composition wood, which may be used as a substitute if the new material is not available. The use of a composition instead of a metal chassis also simplifies the construction for amateur set builders whose workshops do not boast a selection of metal punches and reamers for cutting the socket holes. Small wood cleats support the base so that some of the parts may be mounted underneath.

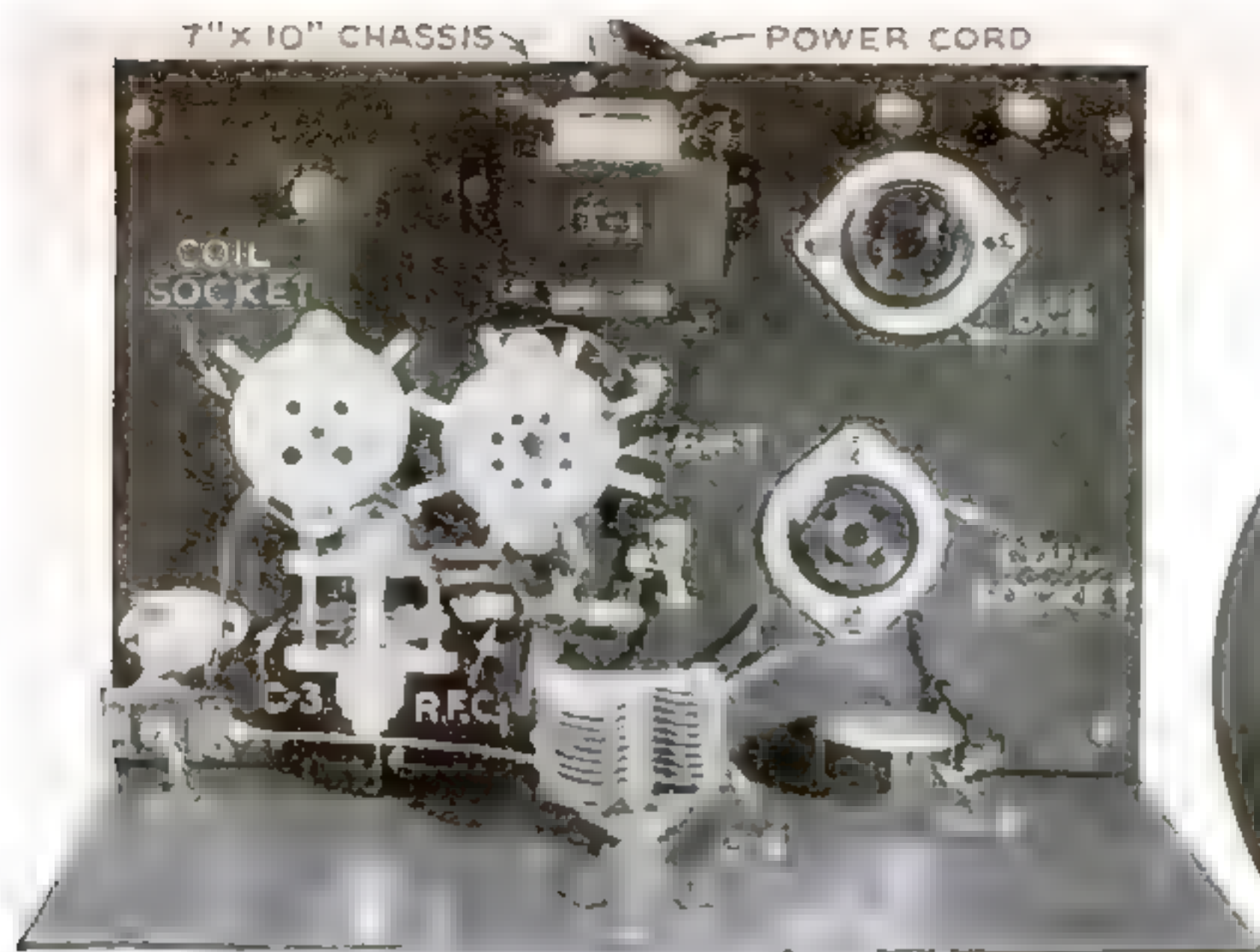
Two isolantite sockets, one an eight-prong unit for the 6N7 tube and the other a four-prong for the superregenerative-detector coils, are mounted on top of the chassis. These sockets should be arranged close together, so that all leads may be kept short. The isolantite-insulated tuning condenser (C_3) for the superregenerative detector should be mounted direct-

LIST OF PARTS

- C_1 .—Trimmer condenser, 0-.35 mmf.
 - C_2 .—Variable condenser, midget, .00014 mfd.
 - C_3 .—Variable condenser, midget, .00002 mfd. (see text).
 - C_4 .—Fixed condenser, midget, .0001 mfd.
 - C_5 .—Fixed condenser, midget, .0002 mfd.
 - C_6 .—Fixed condenser, .006 mfd.
 - C_7 .—By-pass condenser, paper, .25 mfd.
 - C_8 .—By-pass condenser, paper, .5 mfd.
 - C_9 .—Fixed condenser, mica, .001 mfd.
 - C_{10} .—Dry electrolytic condenser, 8 mfd., 550 volts.
 - R_1 .—Fixed resistor, 3 meg., $\frac{1}{2}$ watt.
 - R_2 .—Fixed resistor, midget, 2 meg., $\frac{1}{4}$ or $\frac{1}{2}$ watt.
 - R_3 .—Potentiometer, 0-100,000 ohms.
 - R_4 .—Fixed resistor, 100,000 ohms, 1 watt.
 - R_5 .—Fixed resistor, 1 meg., $\frac{1}{2}$ watt.
 - R_6 .—Fixed resistor, 5,000 ohms, 1 watt.
 - R_7 .—Fixed resistor, 25,000 ohms, 10 watt.
 - RFC_1 .—Short-wave radio-frequency choke *
 - RFC_2 .—Short-wave radio-frequency choke, $2\frac{1}{2}$ mh.
 - T_1 .—Audio transformer, $3\frac{1}{2}$ to 1.
 - T_2 .—Power transformer, 650 volts center tapped, 6.3 volts center tapped, rated at 40 mls. or more
 - Misc.—Dials, chassis, panel, sockets, tubes, wire, solder, etc.
- *Exact rating should be determined by experiment.

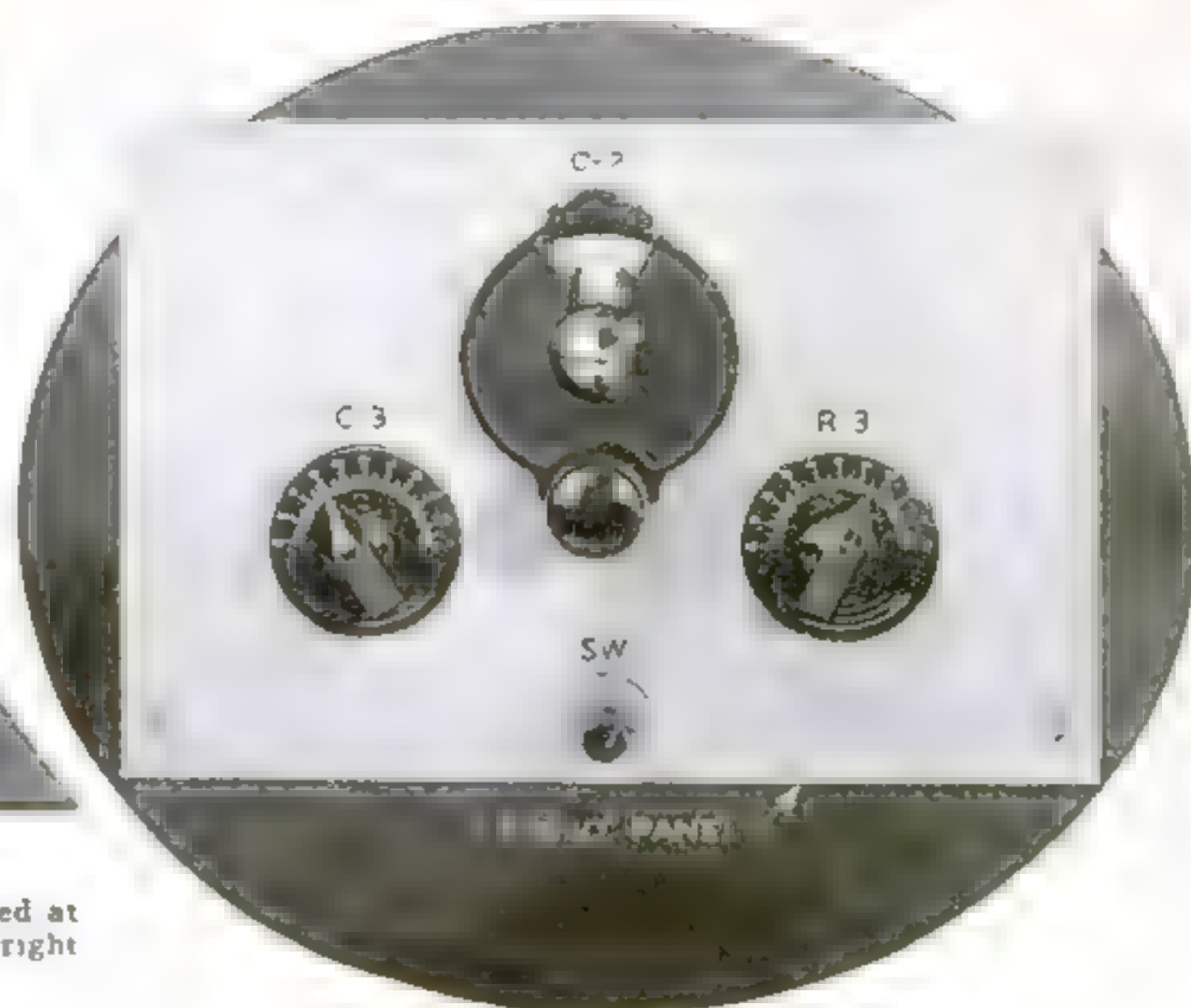


A combination circuit makes two tubes do the work of three. This diagram shows the receiver circuit



Top view of the hook-up. Parts for the superregenerative detector are grouped at the left to make short leads possible. The front panel is pictured at the right.

By STANLEY JOHNSON



Is Two Receivers In One

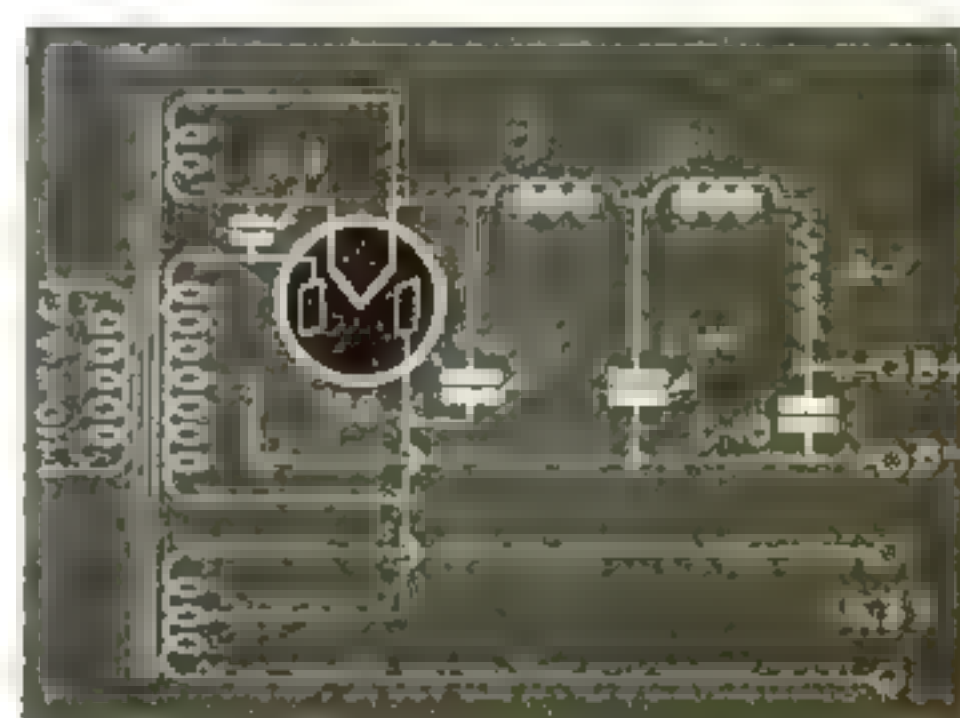
ly in front of the sockets and as close to them as possible. There should be just enough space between the grid terminal of the tube socket and the stator lug on the variable condenser for the midjet grid condenser (C_4) and the midjet grid resistor (R_2). The plate prong on the tube socket and one of the prongs on the coil socket should be wired together with a lead approximately a quarter inch long, running from them to the rotor of the tuning condenser. The other prong of the coil socket should be connected to the second stator lug on the variable condenser. The short-wave, radio-frequency choke (RFC_1) can be wired between the tuning condenser stator and the by-pass condenser (C_6) which is grounded directly to the cathode prong on the tube socket. As in all superregenerative circuits, extremely short leads and high-grade insulation are absolutely necessary.

The audio transformer (T_1) and the

stand-off, antenna insulator also are mounted above the base panel. On the aluminum front panel are the variable resistor (R_3) and the variable tuning condenser (C_2). The variable resistor serves as regeneration control for both the regenerative and the superregenerative detectors. All small parts and wiring for the regenerative detector and the audio stage can be placed beneath the base panel. Although the wiring for the amplifier and the simple detector is not as critical as for the superregenerative portion of the circuit, it is well to observe the usual precautions of keeping leads short and direct and of making all grounding connections to a single cluster of soldering lugs.

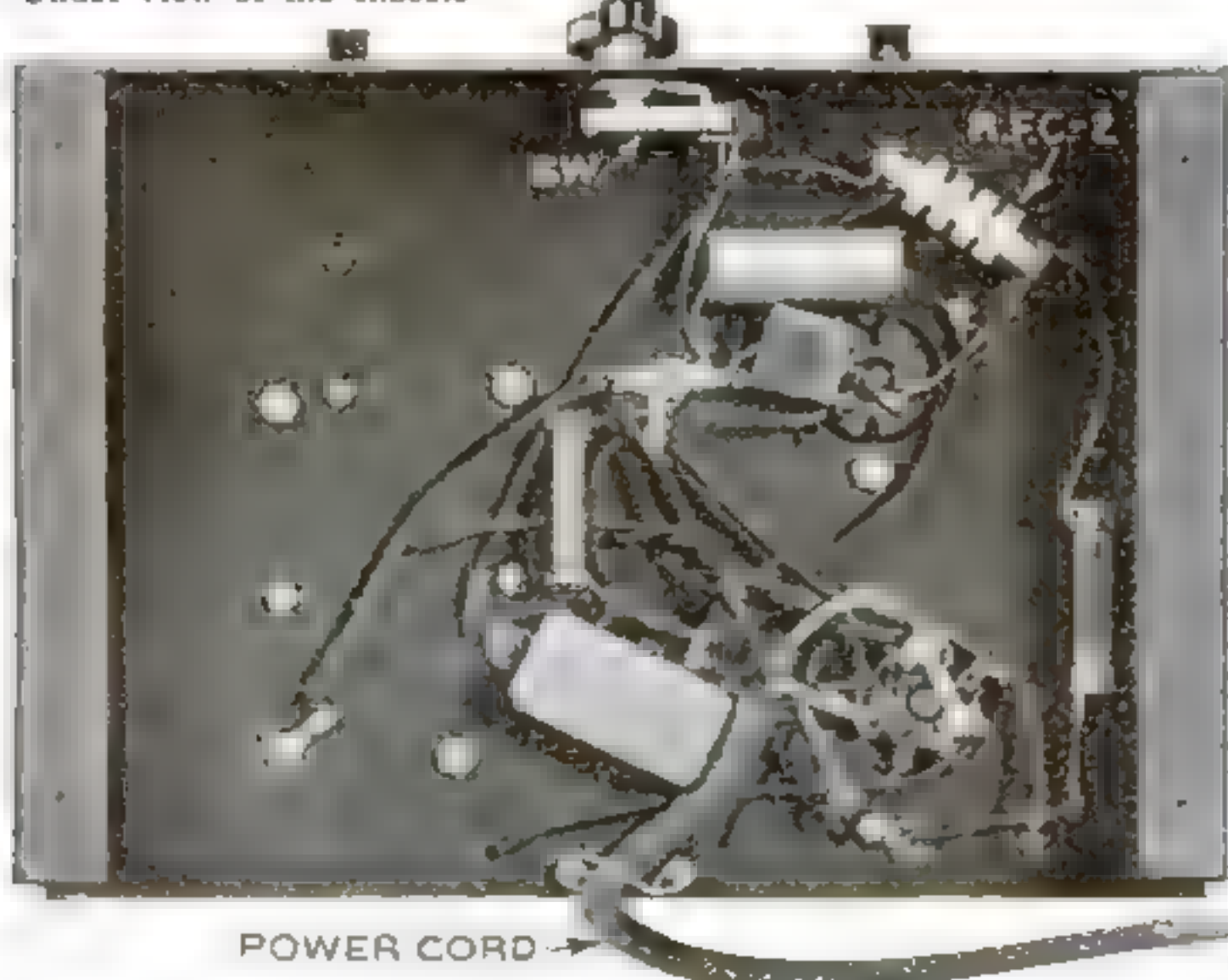
Two methods of antenna coupling are used. A small "postage-stamp" trimmer condenser (C_1) mounted on a stand-off insulator couples the antenna to the grid of the regenerative detector. For the superregenerative circuit, one end of a

piece of insulated hook-up wire is soldered to the antenna clip and the other end is twisted around the grid prong of the coil socket. Several turns will be sufficient. Note that the turns of insulated wire are simply twisted around the prong, no direct connection being made to it. This will provide enough coupling for an antenna of seventy-five feet, a compromise length which gives good results on all bands.



This is the power-supply circuit. It also is ideal for use with a five-meter radiophone.

Under view of the chassis



HOW THE COILS ARE WOUND

REGENERATIVE DETECTOR

	Grid	Tickler	Wire
No. 1	42 turns	6 turns	No. 30 enameled
No. 2	18 turns	4 turns	No. 30 enameled
No. 3	9 turns	3 turns	No. 30 enameled
No. 4	4 turns	3 turns	No. 22 D.C.C.

Coils should be close-wound on 1 1/4-inch coil forms

SUPERREGENERATIVE DETECTOR

No. 1	6 turns	No. 22 D.C.C. wire, spaced to occupy 1 1/4 inch
No. 2	3 turns	No. 22 D.C.C. wire, spaced to occupy 1 inch

Coils should be wound on 1 1/2-inch coil forms

The arrangement of controls on the panel is neat and symmetrical. A little above the exact center is the vernier dial for the regenerative-detector, tuning condenser. Directly below is the single-pole, double-throw switch which provides the means for making the shift from one detector to the other. To the right is the regeneration control and to the left the superregenerative-detector, tuning condenser.

In adjusting the superregenerative detector, you will find that it tunes broadly, making a vernier dial unnecessary. An insulated coupler (*Continued on page 109*)

"Take a look at that junk!" Walton grumbled, pointing toward the bench. "How in Sam Hill can you expect connecting-rod bearings to stay tight when they work like that?"

By
MARTIN
BUNN



DOES YOUR CAR HAVE New-Type Bearings?

JOHN WALTON finished his supper and headed at once for his garage, where he climbed into stained overalls and jumper with a smile of anticipation on his wrinkled face.

Walton was an old-timer. Automobiles had been his hobby since the days of the curved-dash, one-lung ancestors of the modern streamliner. He prided himself on the care he took of his car and on his ability to make virtually any kind of repair. Indeed, his wife always maintained that nothing made her husband happier than the discovery of a new motor noise that would serve as a good excuse for doing another elaborate overhaul job.

Now, after an extended tour in his new car, he fancied he heard sounds which indicated that the connecting-rod bearings weren't as tight as they might be. He was going to give himself the pleasure of taking a look at them.

"Might as well see, at the same time, if the piston rings are all right," he muttered to himself, as he lifted the hood and got out his tool kit.

In a short time he had the cylinder head off, the oil pan removed, and was taking off the first of the connecting-rod caps.

"What in blazes is the matter here?" he sputtered, as he removed the cap and the thin half shell of a bearing dropped out. "Looks like the whole works has gone to pot. Bearing metal came loose from the rod and everything. It's lucky I got at it in time."

He removed two more connecting-rod caps, with the same result. He couldn't find any shims under the bearing cap, where they had been in his old car.

Still muttering angrily to himself, he slid out from under the car, went into the house, and growled the number of the Model Garage into the telephone. "That you, Gus?" he asked, as Gus Wilson, half owner of the establishment answered. "Can you stop in on your way home? I'm in trouble. All the connecting-rod bearings on my car are on the blink!"

Walton was nervously puffing away at a large briar pipe when the veteran auto mechanic showed up, a little later. "Take a look at that junk," he grumbled, pointing toward the bench, on which he had laid out a couple of connecting rods, together with four bearing sections.

"How in Sam Hill can you expect connecting-rod bearings to stay tight when they work like that?" he sputtered indignantly. "Look how the bearing metal has broken away from the rods. Why, the bearing itself has been turning with the crankshaft till it's got the whole inside of the rod surface shiny!"

"They haven't come loose," Gus grinned. "they're made that way in the first place. Take a look at these."

Gus lifted a package onto the bench, unwrapped the paper and spread out a whole set of new connecting-rod bearings.

"Knowing how you used to take pride in scraping a bearing, John," he smiled,

"I was wondering what you'd do when you tried to work on this new type."

Walton picked up one of the new bearing sections and carefully compared it with one he had taken from his own car.

"Well, if that isn't a crazy way to make a bearing!" he exclaimed in amazement. "How can you get it tight with the bearing metal floating loose like that? I should think it would pound itself to pieces. And how do you adjust it? There aren't any shims, so far as I can see."

"It's all in the way they're made and what they are made of," Gus explained. "The kind of bearing you know how to fix is one where the Babbitt metal is fastened to the inside of the connecting-rod big-end bearing and its cap. When it wears, you can take out a shim or two and let the cap part squeeze down on the crankshaft, and then scrape it by hand. That kind of a bearing was used for years, and gave good service. Its only fault is that it takes a lot of work to tighten it, and it isn't every mechanic who has enough skill to scrape a bearing to a fit. That means that tightening bearings was expensive if it was done right, and if you merely tightened the caps without scraping in, the bearing wouldn't last, because all the wear would come on a small part of the bearing surface."

"But when you did the job right, you had a real bearing," Walton interrupted.

"Sure," Gus readily admitted, "but you get just as good (*Continued on page 110*)

NEW Racing Sailboat

Specially designed for beginners to build, BLACKCAT is fast, seaworthy, and inexpensive

By WILLARD CRANDALL

from a design by

BRUCE N. CRANDALL

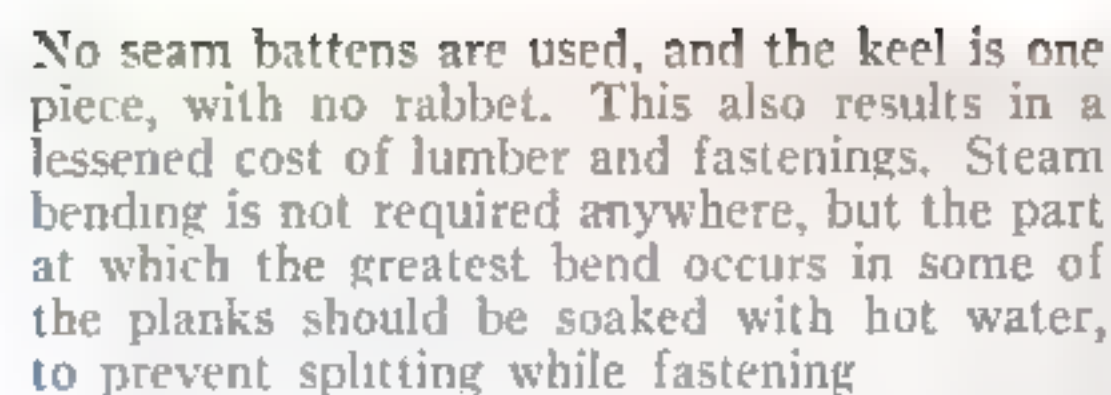
FOR racing or sport sailing, our new Marconter-rigged sailboat *Blackcat* is not only simple and inexpensive to construct, but easy to handle and speedy under a variety of conditions. The boat gives a superior performance in light winds, yet the hull will ride over waves that would usually swamp a craft of this size. *Blackcat* can therefore be used on all waters, from large open bays to the smallest lakes.

It has an overall length of 13 ft. 4 in., and a 5-ft. beam. Despite the sturdiness of the hull for its size, it should have, completed, a weight of only about



Even in light winds, our new sailboat makes an excellent racing craft. The frames (at left) are assembled over full-size patterns as shown below





The bottom is so designed that no fitting of planks is necessary except with the two planks on each side of the keel. The frames are all cut from straight pieces and the same curve may be used for nearly all of the deck beams. The cost of materials for the hull will be less than \$30 in most localities. Though the cost of fitting and equipment will vary greatly with the choice of materials, the total cost should not be over \$75, including sail bought from a professional sailmaker.

Before starting construction, draw full-size patterns of the transom, frames, and stem on fairly heavy wrapping paper, following the measurements given on the drawings. The measurements in the table of offsets are

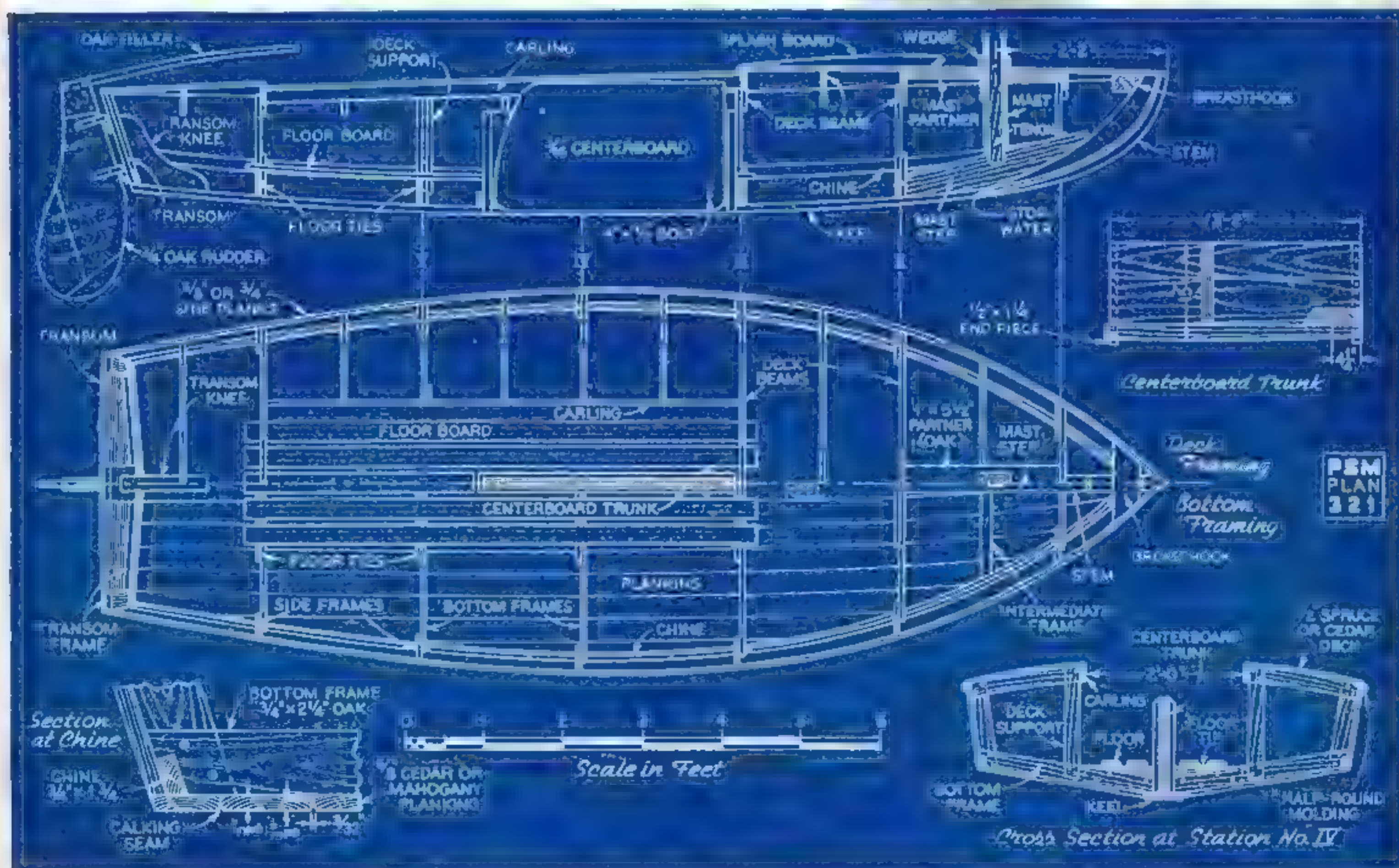
Above: See that frames are square and chines form a true curve.
Right: First fit lower planks at sides, then the bottom planks

250 lb., which makes transportation on a trailer easy.

Fleets of half a dozen or even fewer of these *Blackcats*, matched against each other, will offer the most keenly competitive, thrilling, close-finish racing that any yacht club could ask.

The Marconi cat rig provides for a fair proportion of the sail high near the masthead, where it is most efficient. The use of a sail track facilitates the removal of the sail so that it may be stored easily when not being used. This is an advantage that contributes toward longer life for the sail.

The construction is as simple as is possible for any boat, excepting only a flat-bottom skiff or a scow type.



to the outside of the planking, and it will not be necessary to use them unless it is desired to draw the entire boat full size before making the patterns.

Draw a pattern for deck beam No. 3 with a compass made by tying a long string to a pencil. This same curve may then be used for all deck beams except the intermediate between Nos. 6 and 7, and the top of the transom. Ahead of frame No. 3, the crown is greater, so the deck will take a slight V-shape.

Lay the frame stock over the patterns, mark, and cut to shape; then fasten the frame pieces together over the patterns. The frames may be fastened at the joints

with 1½-in. No. 10 flathead screws, with 2-in. No. 10 machine screws, or with copper rivets. Allow enough space for the chine notches and for the beveling of the forward frames. Screw the transom to the transom frames and mark the center line on the frames and transom.

Cut the stem, mast step, and transom knee from a 2½-in. piece (2 in. is thick enough if oak is used). The stem and mast step should be fastened together with 2½-in. No. 12 screws and several 4 by ¼-in. bolts. The transom knee is fastened to the transom, and later to the keel in the same manner.

It is easiest to build the boat upside

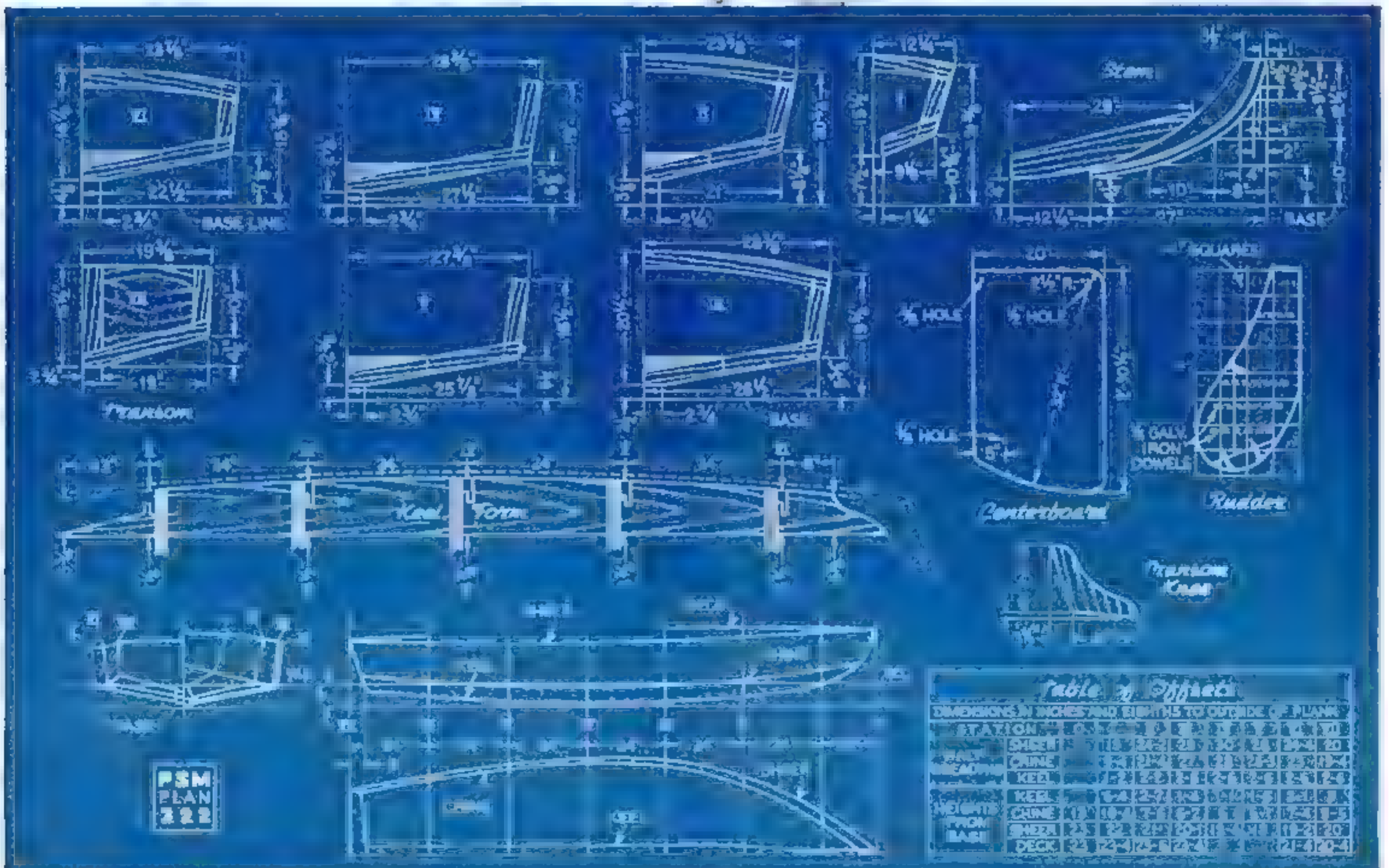
down on a framework supported from the floor, or from two timbers as shown in the photographs. The essential part will consist of a form on which the keel, stem, mast step, frames, transom knee and transom will rest. Cut the keel form from a 1 by 10 in. by 11-ft. plank according to the measurements given on the drawings. Nail uprights at stations Nos. 2, 3, 4, 5, and 6, and set up and brace as illustrated in the photographs. The uprights must be perfectly plumb and at right angles to the keel form. Cut notches to the exact depth of the frames and floor ties. Set the frames in the notches and put one bolt through each bottom frame and deck beam so that the center lines will be perfectly plumb and at the center of the keel form.

The keel, stem, mast step, transom knee, and transom can now be set in place. The keel will be tapered forward until it is the thickness of the stem where the two meet. Fasten the keel to the floor ties, frames, and transom frame with 1½-in.

No. 10 screws, and to the mast step and transom knee with 2½-in. No. 12's. The transom should be beveled and then coated with white lead or marine glue in order that the joint will be water-tight, before the keel is fastened to it.

Notches for the chines may now be cut in the frames and transom frame. First clamp the chines in place to be sure of getting a true curve and the proper bevels. Screw frame No. 1 to the stem at the correct location. The rabbet may now be cut in the

Fastening the first side plank. It is afterwards dressed flush with the chine so that the bottom planks can lap over it.



stem to the thickness of the planking. A light batten bent over the frames will show the correct angles. Cut notches about $\frac{1}{2}$ in. deep in the stem for the chines.

Screw the chines to the stem, frames, and transom frame with $1\frac{1}{2}$ -in. No. 10 screws. Before fastening, see that the chines are in a true curve and that the frames and transom are at right angles to the keel. Next, bevel the chines, transom, and frames so that the planking will fit perfectly. Check the entire framework to be sure it is perfectly true and fair. Before starting the planking, cut a waterway through the frames on each side of the keel, and drive a softwood plug between the stem and keel, which will swell and act as a stopwater.

Start the planking with the bottom side plank, a 10-in. piece. When it is in place, continue with the planks next to the keel, the garboards. They will have to be fitted to the keel and stem and to the side planks at the bow. Fit these planks by clamping them in place and then marking out the shape with an ordinary pencil compass. This is the only plank fitting required in the whole boat.

The remainder of the bottom planks, the top plank on each side, and all the decking can be put on in perfectly straight pieces. Dress the bottom side plank down flush with the chine and let the rest of the bottom planks lap over it. The bottom will be easier to plank if not over 4-in. widths are used. Before each plank is put on, the edge should be planed off so as to leave a V-shaped calking seam as shown. They should then fit tight on the inside.

Before the planks are screwed down, the chines, stem and transom should be coated with marine glue or white lead. Strips of cotton flannelette, coated on both sides, are laid on to make a completely water-tight joint. Fasten the bottom planking to the frames, stem, transom frame, and chines with $1\frac{1}{4}$ -in. No. 8 flathead brass or galvanized screws, countersunk enough to be covered later with putty. Screws should be spaced about 1 in. apart at the transom and stem and about 2 in. apart along the chines of the boat.

Before the top side plank is put on, the boat should be removed from the supporting form and set right side up on horses. Some of the deck frames will have to be temporarily removed to do this. The top side plank should be carefully dressed down so that the sheer line will be true.

(TO BE CONCLUDED)

List of Materials

Mahogany, cypress, cedar, white pine, redwood, spruce, fir, or yellow pine

For	No.	Pc.	Size
Side planking	2		$5\frac{1}{8}$ " x 10 " x $1\frac{1}{2}$ "
	2		$5\frac{1}{8}$ " x 6 " x $1\frac{1}{2}$ "
Bottom planking and floor boards	14		$5\frac{1}{8}$ " x 4 " x $1\frac{1}{2}$ "
Transom and centerboard well	1		$3\frac{1}{2}$ " x 6 " x 10 "
	1		$3\frac{1}{2}$ " x 10 " x 10 "

Spruce, cedar, mahogany, cypress, fir, white pine, redwood, or yellow pine

For	No.	Pc.	Size
Decking and splash board	13		$\frac{1}{2}$ " x 4 " x $1\frac{1}{2}$ "

Oak, mahogany, spruce, fir, cypress, or yellow pine

For	No.	Pc.	Size
Keel and mast partner	1		1 " x $5\frac{1}{2}$ " x $1\frac{1}{2}$ "
Rudder	1		$3\frac{1}{4}$ " x 10 " x 3 "
Chines	2		$3\frac{1}{4}$ " x $1\frac{1}{4}$ " x $1\frac{1}{2}$ "
Bottom frames, side frames, and transom frames	3		$3\frac{1}{4}$ " x $2\frac{1}{4}$ " x 12 "
Floor ties and tiller	1		$3\frac{1}{4}$ " x 6 " x 10 "
Stem, mast step, transom knee, and breasthook	1		$2\frac{1}{2}$ " x 8 " x 6 "

Spruce, fir, mahogany, yellow pine, or cypress

For	No.	Pc.	Size
Deck beams, carlings, and deck supports	2		$3\frac{1}{4}$ " x 12 " x 10 "
	2		$3\frac{1}{4}$ " x $2\frac{1}{4}$ " x 12 "
Mast	1		1 " x $2\frac{1}{4}$ " x 4 "
	2		$1\frac{1}{2}$ " x $3\frac{1}{2}$ " x 20 "
	1		$3\frac{1}{4}$ " x 1 " x 20 "
	1		$1\frac{1}{2}$ " x 1 " x 20 "
Boom	2		$3\frac{1}{4}$ " x $3\frac{1}{2}$ " x 12 "

Oak, mahogany, spruce, fir, cypress, or pine

For	No.	Pc.	Size
Half-round molding	2		$1\frac{1}{2}$ " x $1\frac{1}{2}$ " x 16 "

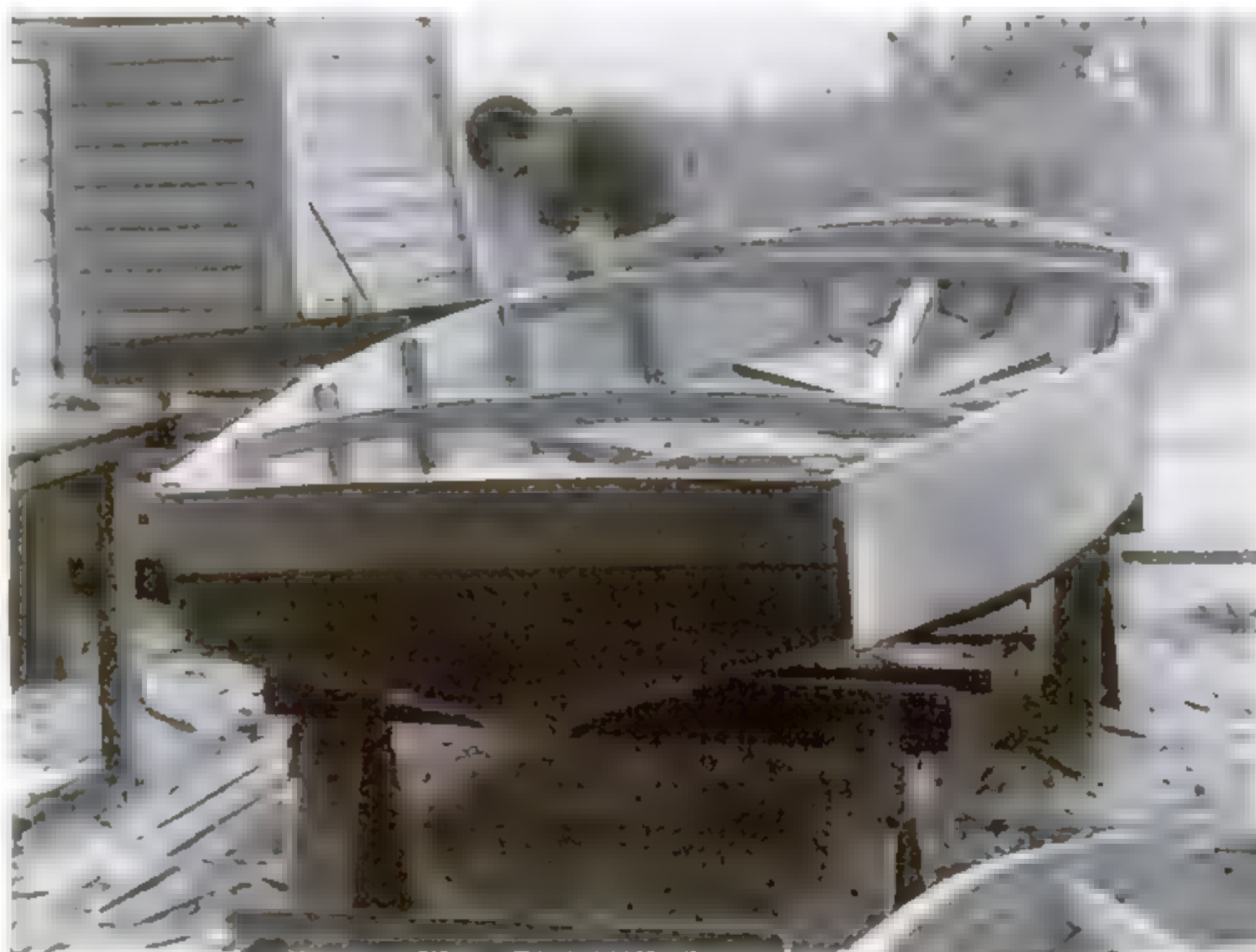
Note: Materials are listed in order of preference.

FASTENINGS

Flathead brass or galvanized screws as follows:
5 gross $1\frac{1}{4}$ " No. 8; 1 gross $1\frac{1}{2}$ " No. 10 4 doz. $2\frac{1}{2}$ " No. 12.
1 gross roundhead brass screws, $\frac{3}{4}$ " No. 6.
2 lb. 1" copper or galvanized wire nails and 1 lb. $1\frac{1}{2}$ " copper or galvanized wire nails.
4" x $\frac{1}{2}$ " brass centerboard bolt.
Brass or galvanized machine bolts as follows:
10— 4 " x $\frac{1}{4}$ "; 2— 3 " x $\frac{3}{4}$ "; 3— 2 " x $\frac{3}{4}$ ";
3— 1 " x $\frac{1}{4}$ ".
1 doz. $\frac{1}{4}$ " brass or galvanized washers.
2 ft. $\frac{1}{4}$ " iron rod, galvanized.
3 ft. $\frac{3}{8}$ " x $3/16$ " half-oval brass or gal. iron

MISCELLANEOUS

1 qt. spar varnish and $\frac{1}{2}$ gal. marine paint.
4 lb. elastic seam composition or putty
3 balls cotton wicking for calking.
1 lb. waterproof casein glue, 1 pt. marine glue
3 open base cleats, $3\frac{1}{2}$ ", and 1 open base cleat, 5".
1 small boat boom fitting (gooseneck).
1 cheek halyard block, $\frac{3}{4}$ ".
1 sheave, 2 " x $\frac{3}{4}$ ". 3 blocks for sheet, $\frac{3}{4}$ ".
1 traveler for sheet (optional).
1 shackle for halyard, $\frac{3}{4}$ ". 3 chain plates.
6 wire-rope thimbles, $3/16$ ".
3 turnbuckles, $\frac{3}{4}$ " x 4 ".
45 ft. galvanized rigging rope, $3/16$ ".
2 flat brass for tangs, 1 " x $\frac{3}{4}$ ".
50 ft. manila rope for halyard, $\frac{3}{4}$ ".
25 ft. manila rope for sheet, $\frac{3}{4}$ ".
28 ft. sail track, $5/8$ " (sail slides are usually furnished by the sailmaker).
2 pintles, $\frac{3}{4}$ ". 2 screw gudgeons, $\frac{3}{4}$ ".
Centerboard $3/16$ " bronze, galvanized iron or boiler plate.
Sail of $4\frac{1}{2}$ -oz. sailcloth



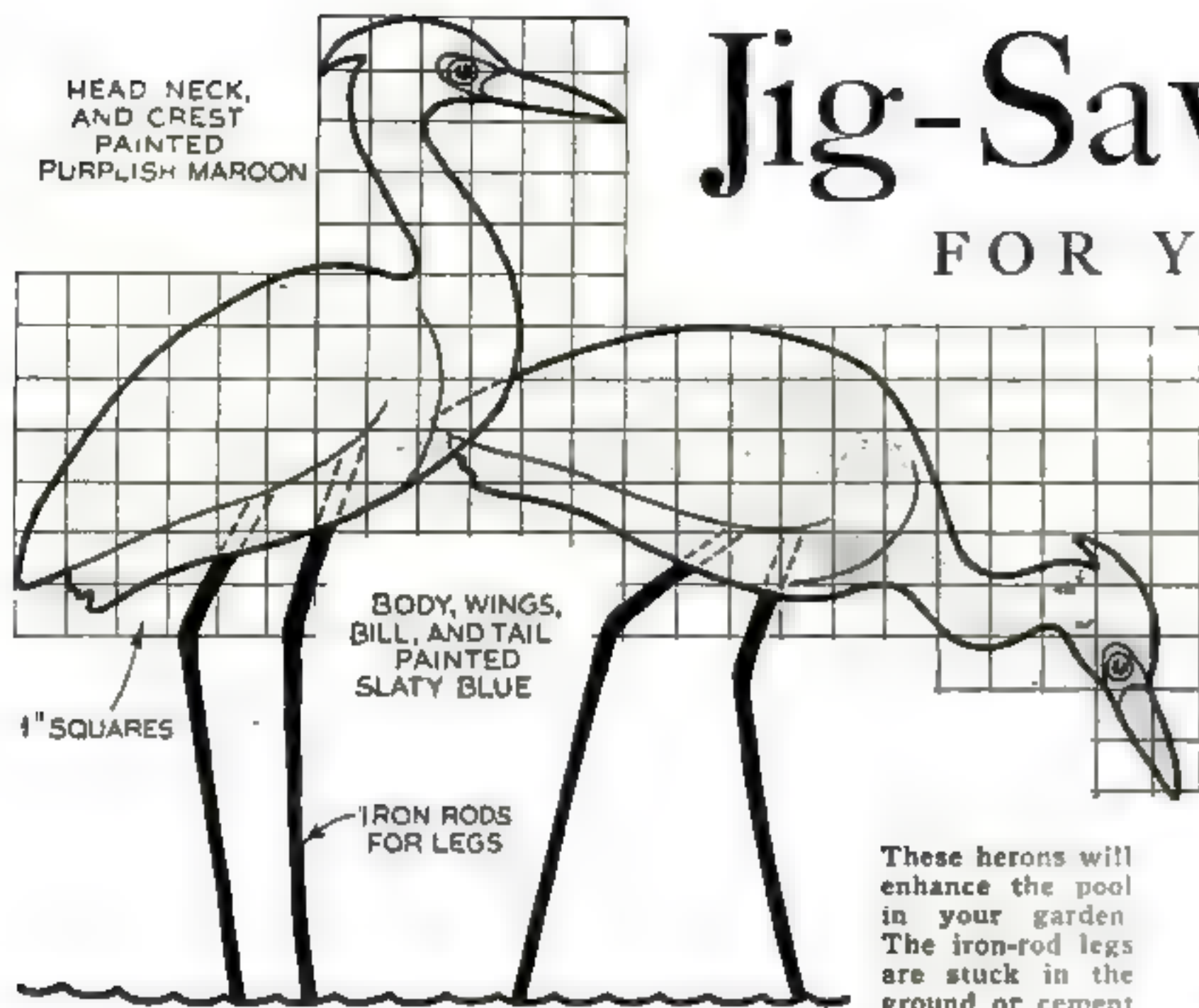
The boat should be removed from the form and placed right side up on horses before putting the top side plank in place. Then dress it down so the sheer line will be true



Above: The stem, showing how a rabbet is cut to the thickness of the planking. The keel is tapered forward until it is the same as the stem where the two meet

At left: It is best to assemble the frame on a form supported from the floor or resting on a pair of heavy timbers

HEAD, NECK,
AND CREST
PAINTED
PURPLISH MAROON



These herons will
enhance the pool
in your garden.
The iron-rod legs
are stuck in the
ground or cement

Jig-Sawed Herons

FOR YOUR LILY POOL

CUT from wood and painted in natural colors, a pair of little blue herons will enhance a garden lily pool, especially if placed at the back near tall foliage.

Cut the shapes from 1-in. stock, narrow the bills somewhat, and use iron rods for the legs. The diagrams give the legs only as far as they are to show; they should be extended sufficiently to be fastened.

Mix a slaty blue for the body, wings, bill, and tail by adding black and perhaps some white to blue. Darken this color for the legs. Mix a purplish maroon for the head, neck, and crest by adding a small amount of blue and brown to red.—HAZEL F. SHOWALTER.

STORING SCRAPS OF WOOD

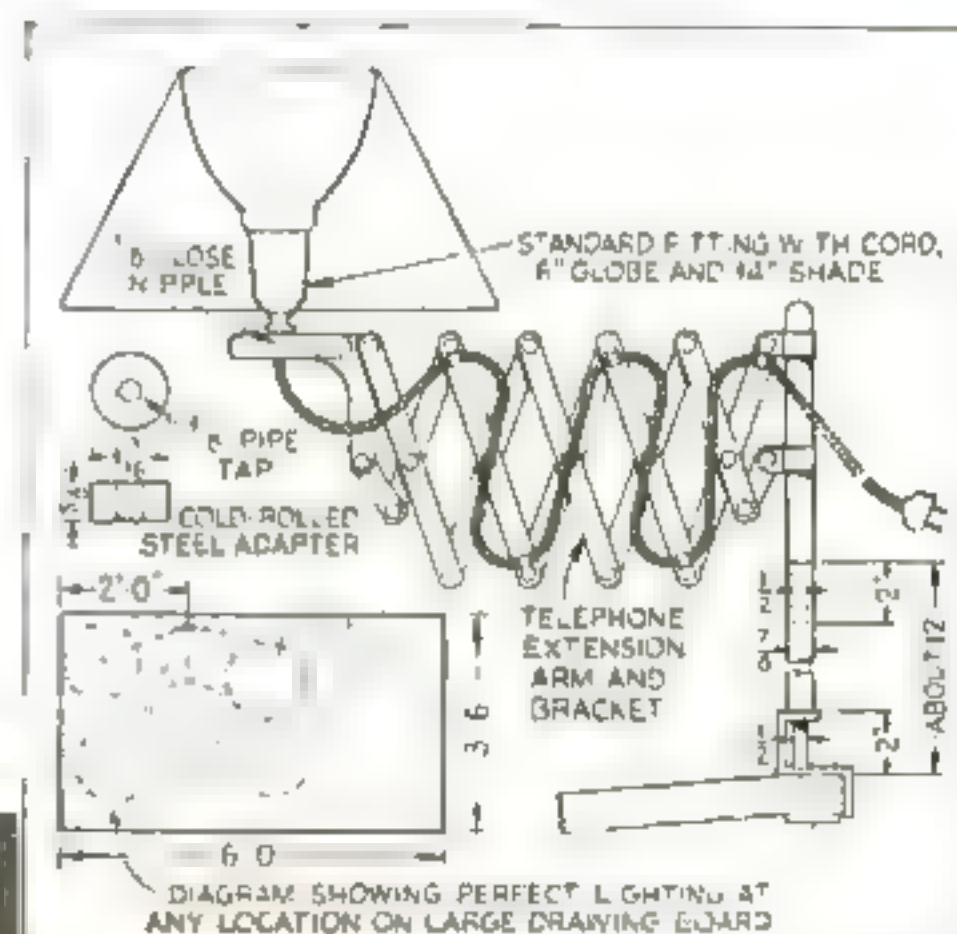
IF SCRAPS of lumber are thrown in a corner or piled at random, it usually takes more time to find a suitable piece for an odd job than the material is worth. It therefore pays to trim one end of each waste piece square and smooth on the power saw and mark the length on the end with a large, soft lead pencil. Sort the scraps into groups, such as from 12 to 18 and 18 to 24 in., and pile them neatly, the marked ends out, under the bench or in any convenient place.

The initial of the species may also be marked on the end when it is difficult to tell what the wood is by the appearance of the end. If the piece contains a knot, the letter *K* may be marked after the length, or the letter *X* to indicate other imperfections.—H. N. ROWLAND.



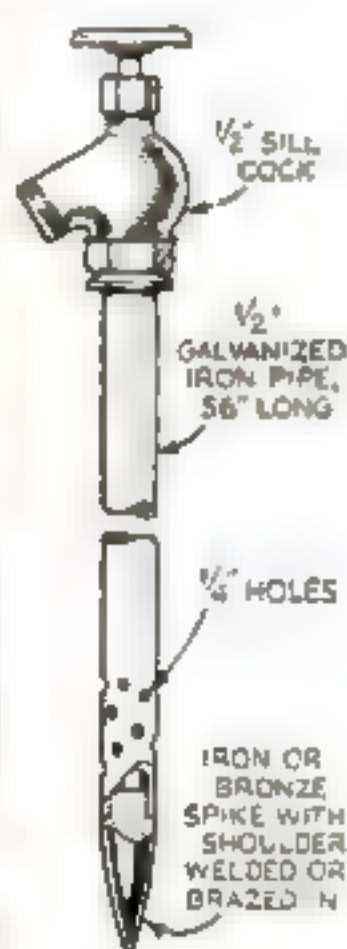
BETTER LIGHT FOR DRAFTING

ADEQUATE lighting of a large drawing board or layout table, always difficult to obtain, is insured by the light illustrated. All parts are standard with the exception of an extension rod and an adapter collar. The electric cord is of the type sold for converting old-style floor and table lamps into the modern inverted I.E.S. type. The globe holder fits the usual 6- or 8-in. globe, and a standard shade may be purchased to fit either size. In the installation shown, a 6-in. globe with a 100-watt lamp is used.—H. W. RAMBOW.



Above: How the lamp, telephone extension arm and bracket, and the vertical rod are fastened to provide wide adjustability

Left: With this arrangement, the light can be placed exactly where needed. The illuminated area is large with no glare



By constructing a device such as is shown above, water can easily be made to reach any deep roots

PIPE IRRIGATOR WATERS ROOTS DEEP IN GROUND

GETTING water to the deep roots of trees or shrubs is not an easy matter without disturbing the roots or injuring them. An irrigator made as shown does the work conveniently, and its cost is negligible as compared with commercial devices of similar type and equal efficiency.—H. S.



Unusual Flat Turnings

ORNAMENT THIS

Sewing Cabinet

Even the handle is turned, the waste portion being scroll-sawed away later to form a grip in the middle

By D. A. PRICE

FLAT turnings of unusual type make this Priscilla sewing cabinet a novel and instructive project for the amateur woodworker.

The two legs are turned at once from two pieces of stock $1\frac{3}{16}$ by $2\frac{5}{8}$ by about 23 in., which are previously glued together with paper between and dressed to $2\frac{1}{2}$ in. wide. The ends must be squared and punched on the split line in the exact center so that the design, when turned, will be symmetrical. To prevent chipping, run the lathe at high speed and use the point of the skew chisel to nick the corners where the round design runs into the square. It is best to use the so-called "scraping" method.

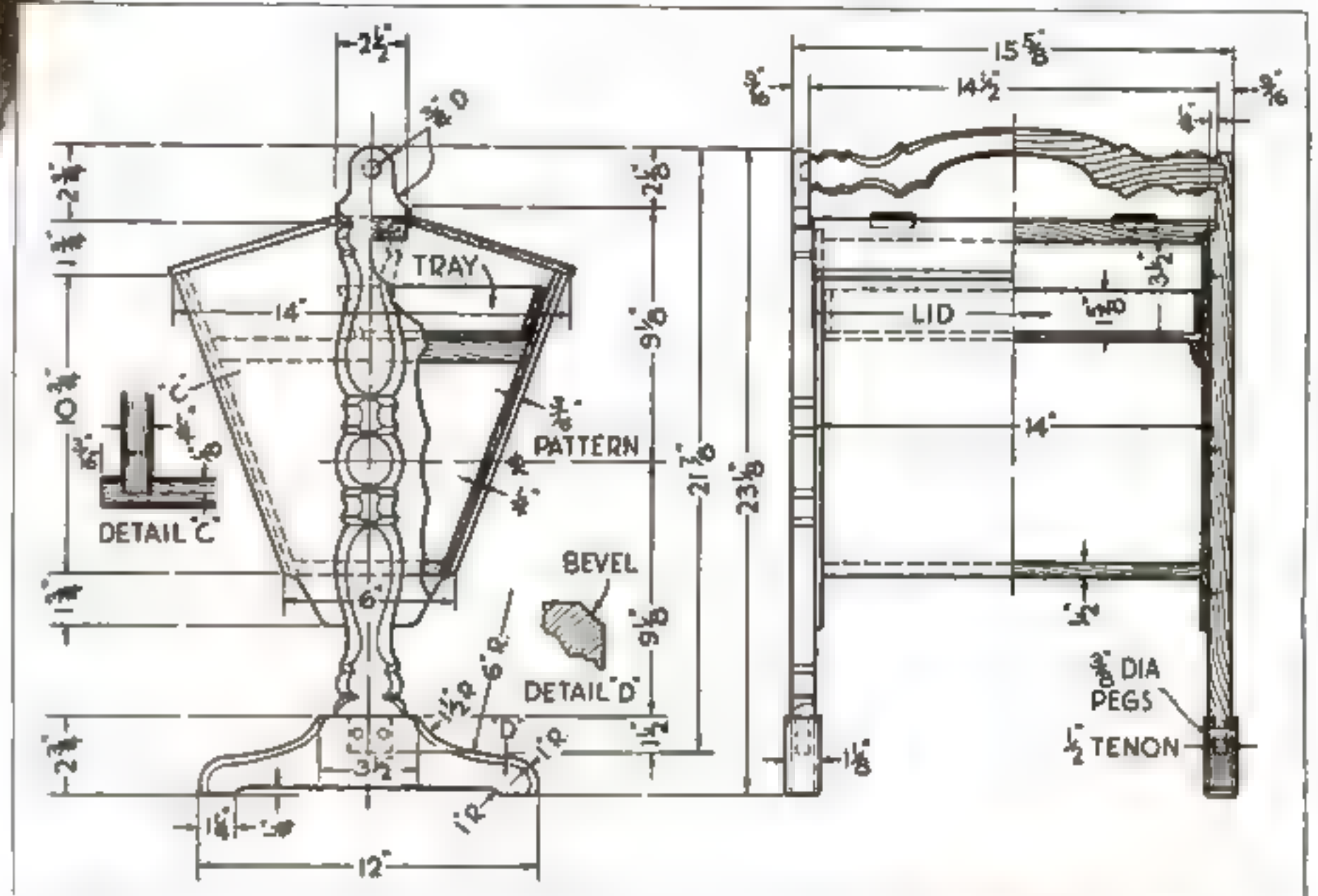
Split the turned halves apart at the paper line, cut a tenon on the lower end, and recess the upper end $\frac{1}{4}$ in. to clear the lids when raised. Round off as shown and bore for the handle tenons.

If a shaper is available, the feet, after

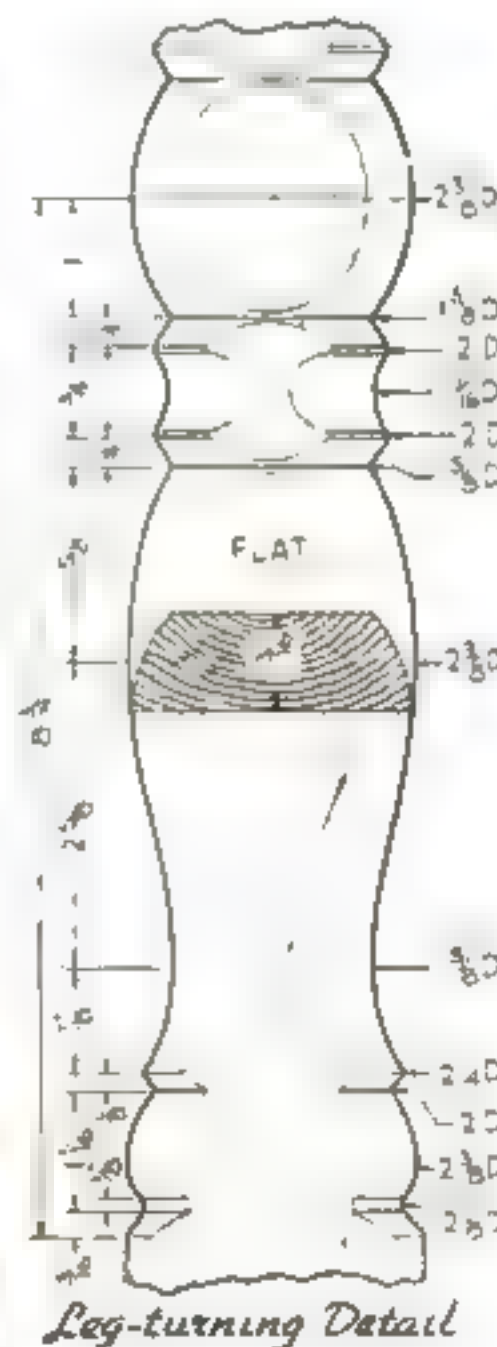
being band-sawed, may be molded quickly by using a pattern or template; otherwise they are scraped, filed, and sanded to outline.

Plywood or solid wood $\frac{1}{4}$ in. thick is used for the body. Note that the center stretcher, of $\frac{3}{4}$ by $2\frac{1}{2}$ -in. stock extends beyond the body $\frac{1}{4}$ in. after the ends are notched.

The handle also may be turned on the lathe as illustrated and the waste portion scroll-sawed away.

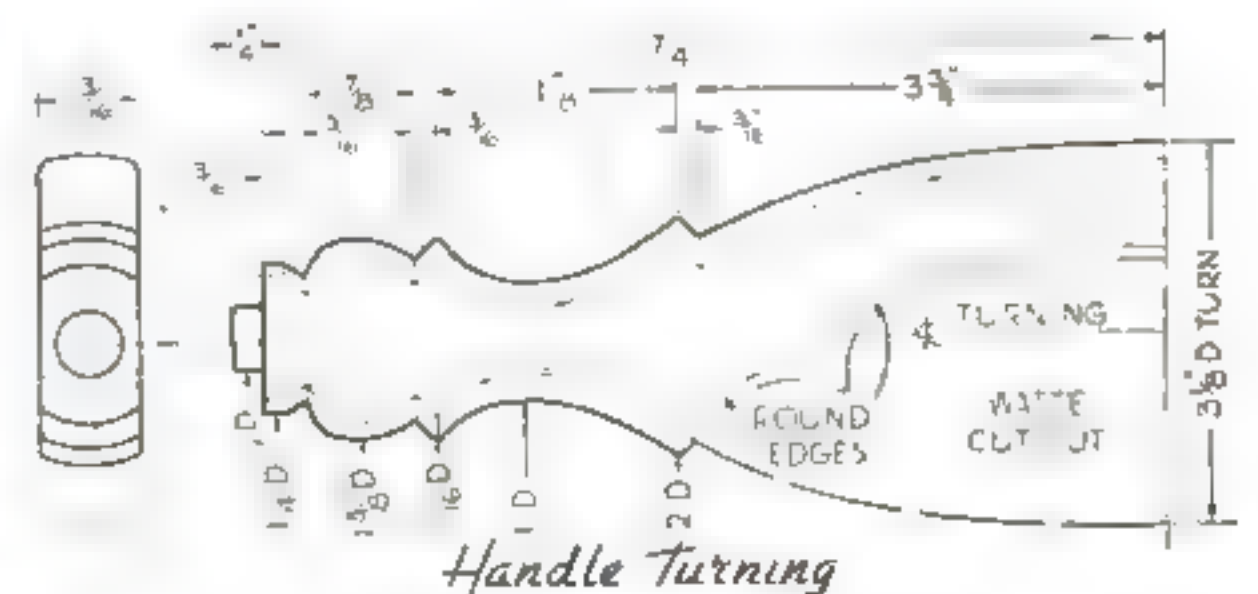


Side and front views, and a detail showing how the ends are grooved along each slanting edge to receive the sidepieces



Completed cabinet with one lid up to show the tray. The flat faces of the legs have a design all their own, yet in harmony with the turned outline, as shown more clearly in the detail drawing at the left

Below: Both legs are turned at once from two pieces of stock glued up with paper between. They are afterwards separated on the paper line. Right: A foot is being molded on a shaper to match a wood pattern



A pattern for half the handle. The end view shows the degree to which the edges of the flat stock are rounded



After the frames are scrubbed with a soapless washing powder, they are sanded to the bare metal and cleaned with steel wool and alcohol if in bad shape. Below: Applying metal primer



RALPH G. WARING gives

step-by-step instructions for

Painting Your BICYCLE



"OUR troop is going to be mounted on bicycles for a lot of outing trips this summer," said Scout Master Bradley. "We have just inspected the wheels, and some are in pretty bad shape. What we'd like to do is to paint them all a uniform color because that would make a snappy looking troop."

"A fine idea," I agreed. "Just take some notes on this pad while I outline the best way to repaint bicycles. Let's start with those that are badly scarred and lacking in paint."

While I talked, Bradley scribbled away industriously, and his notes were about as follows—a concise guide for anyone who has a bicycle to refinish:

1. Remove wheels, overhaul bearings, make necessary repairs. Have any cracked joints welded.

2. Scrub with trisodium-phosphate (soapless) washing powder—1 cup to 1 gal. hot water. Remove every trace of oil, grease, and dirt.

3. Sand to the bare metal with No. ½ garnet waterproof sandpaper and water (or use ordinary garnet paper dry). For stubborn spots, dip quarter-size sheets of the sandpaper in denatured alcohol. Use a flat, thick pad of No. 2 steel wool dipped in alcohol to remove the last traces of paint and grease. Wipe with rags; rewipe with clean cloths and alcohol. Do not touch frame again with hands, but handle with clean cotton gloves or clean rags. Hang frame on wire hooks convenient for painting.

4. Brush on a coat of metal primer reduced according to directions on can. Let



Aluminum enamel is brushed on the cleaned, polished wheel with a careful drawing stroke

dry overnight or until hard enough to sand with No. 6/0 paper, if necessary. Two coats may be required to get a smooth, level base. Use a soft bristle brush of the fitch or bear type. Use a circular stroke around the tubing, then a long and light stroke to tip off the work. Do not brush too much.

If a bicycle has a few bare metal spots but otherwise is in good condition, the paint does not have to be removed. Proceed as in operations 1 and 2, then sand the frame enamel smooth with No. 0 garnet paper. Take pains to feather out the edges where the paint has been chipped off

or scratched deeply. Wipe with a cloth slightly moistened with alcohol, but don't take off any paint. Brush a coat of metal primer on all exposed metal, let dry hard, sand with No. 6/0 paper, touch up again wherever necessary, and redry hard.

A wheel in very good condition merely requires to be cleaned with the trisodium-phosphate solution and given a complete sanding with No. 6/0 waterproof paper and water to level off the surface and provide "tooth" for the new enamel coats.

All three classes are now ready for the next step. First, however, you must buy a fast-drying, self-leveling, hard, tough enamel. The cost will be from seventy-five cents to a dollar a pint, but it will be worth it, since a pint of such high-grade enamel will be ample for two coats. Use the same soft bristle brush, but wash it absolutely clean in fresh turpentine. Do not wipe it dry with rags, but snap the brush towards the floor to remove the turpentine.

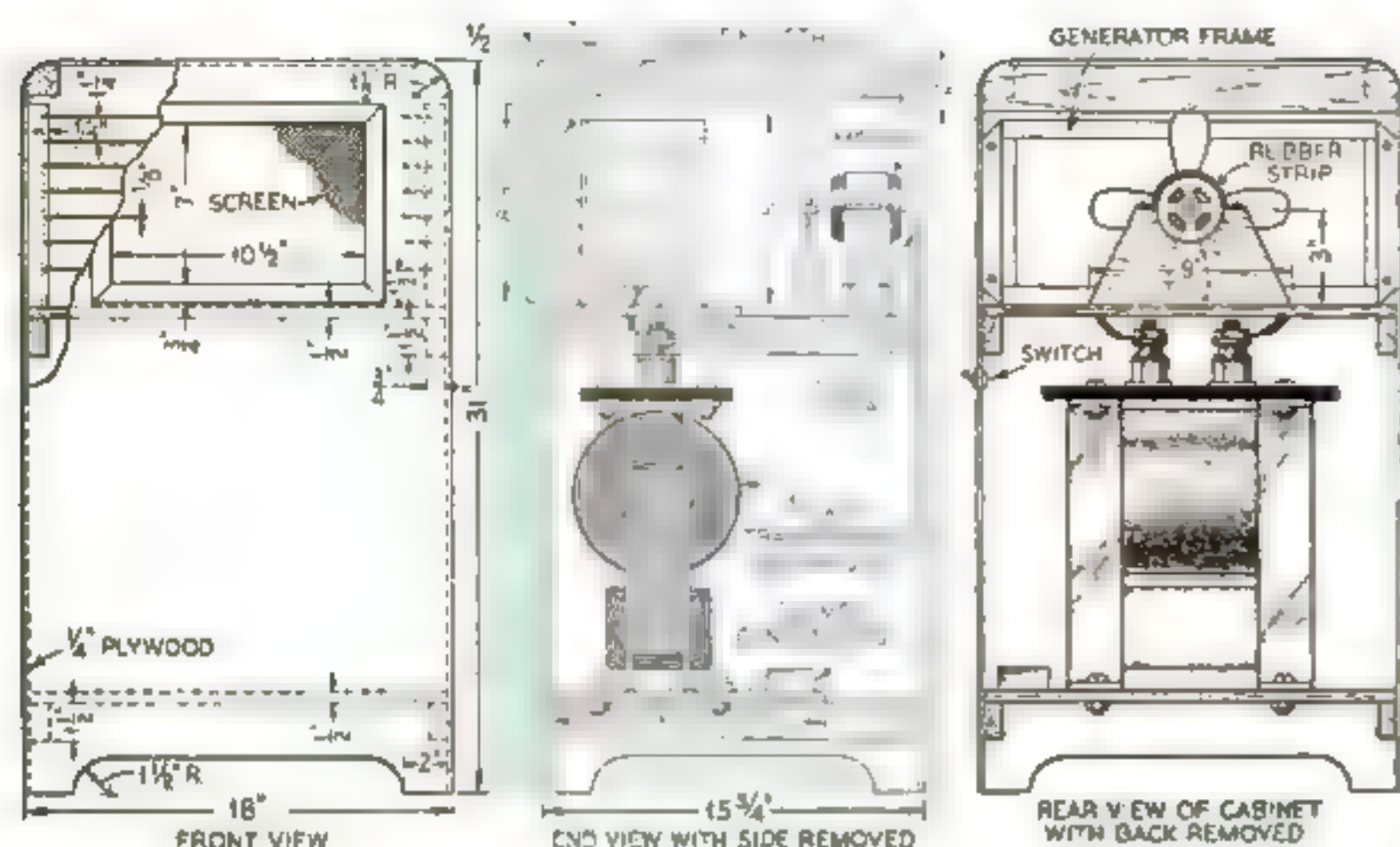
Wipe down the walls of the shop or workroom with damp cloths, wipe every ledge where dust may lodge, and mop the floor with hot water. Stir the enamel, if fresh, with a metal strip or a table knife; do not use wood or particles will spoil the enamel. Heat the room to 75 deg. F. The operations may then be resumed as follows:

5. Wipe frames carefully with a tack rag, either commercial or homemade (see P.S.M., Feb. '37, p. 81).

6. Work the brush gently in a little enamel; wipe clean on the strike-wire of the cup; then dip in about ½ in. and start to flow the enamel on the portions of the frame seen least of all. End with the parts that are most visible. Use as few strokes as possible. The brush stroke should be lifted from the work on a finished portion. Wipe out the brush on the strike-wire, and quickly and lightly tip off the still wet enamel by stroke. (Continued on page 101)

Electric Ozone Generator

PURIFIES AIR OF ROOM



The complete ozone generator fits into a comparatively small cabinet. There are three principal parts—high-voltage transformer, generating device, and small fan



By

E. A. RERUCHA

HOW can I build an ozone generator for purifying the air of a room?" is a question readers sometimes ask.

The most practical and economical method of producing ozone is by means of silent high-voltage discharges from the secondary of a high-voltage transformer. This is the method used commercially.

The Transformer. An ordinary high-voltage radio transmitting transformer of $\frac{1}{4}$ -kilowatt producing a secondary voltage of 5,000 volts will be satisfactory. A new one costs about \$25 from amateur radio supply houses, and secondhand ones are occasionally available from old "ham" radio experimenters. Neon sign transformers are excellent for the purpose. They may be obtained new for about \$15, and there are plenty of them to be had secondhand. The one I used has a secondary voltage of 7,500, and in an experimental set-up it proved just as good as the other transformer.

A suggested arrangement is given in the drawings for an outfit using the $\frac{1}{4}$ -k.w. transformer because this involves the more complicated problem. If a neon transformer is substituted, the condensers and ground need not be used. The secondary current is only 15 milliamperes, and the secondary is already grounded to the frame. The transformer is merely connected to the 110-volt line, and the secondary leads to the electrodes.

Ozone Generator. Copper electrode plates, insulators, and glass dielectric plates are mounted as shown at the right. The spacing is adjusted to suit the length of the insulators, the glass plate that serves as an insulating barrier between the two electrodes being placed in the center.

Each of the two generating units requires a good quality, thin glass plate 5 by 7 in., such as can be obtained by removing the emulsion from a glass photographic

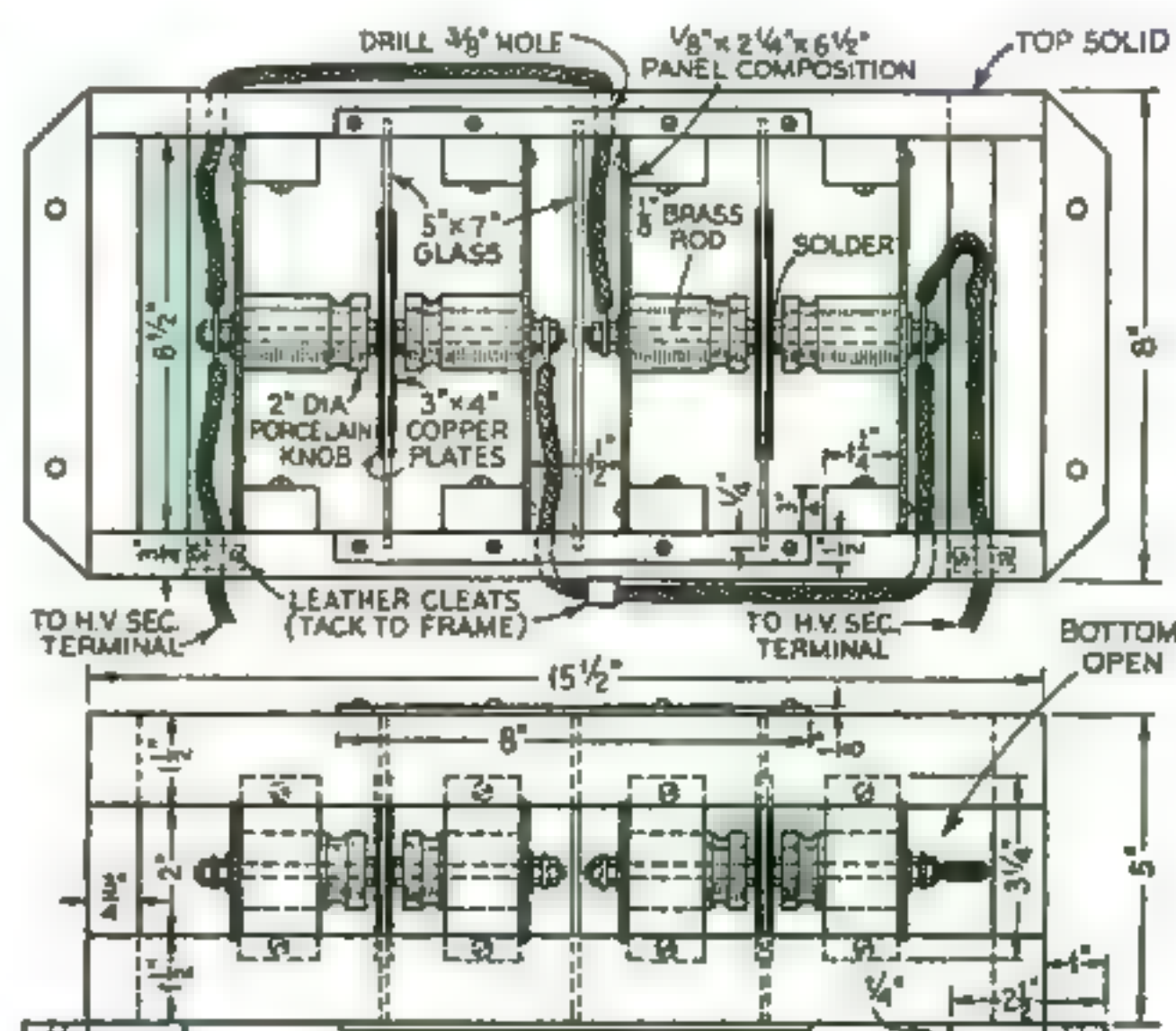
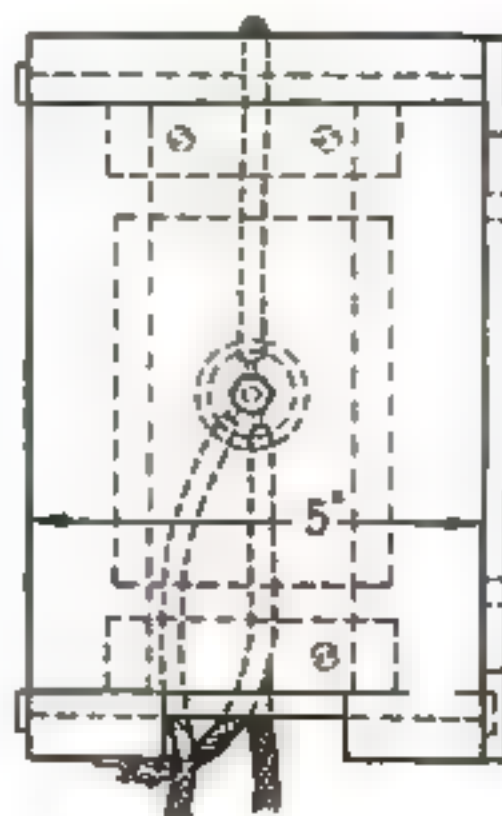
plate. On opposite sides of each plate are the 3 by 4-in. electrodes, of 28-gauge copper. These are soldered at the center to the ends of the threaded brass rods and also to the nuts. The cross supports, of hard panel composition, should be so placed that the copper plates are pressed firmly against the glass plates. The edges of the copper plates are stuck to the surface of the glass with cellulose tape, the copper being accurately centered on the glass.

High-tension, rubber-covered ignition cable is used to make the connections between plates and transformer terminals, a single length being used from one plate to the other and to the terminals. Use brass washers on each side of the cable and tighten the nuts securely so prevent disconnection of the cables and a possible serious short circuit. Support the cables with leather

cleats. Keep each of them as far as possible from the opposite transformer terminal lead and electrode and from the low-voltage wires of the primary circuit. The primary circuit to the transformer, switch, and fan is wired with No. 14 house wire supported on porcelain cleats.

Assembly. Mount the parts in a suitable cabinet as shown in the general assembly drawings. The deflecting strips are $\frac{1}{8}$ by $1\frac{1}{2}$ -in. plywood set in slots. Two turns of rubber from an old inner tube are wrapped around the motor before fastening the metal clamp. It pays to set the transformer on rubber cushions to eliminate as much of the hum as possible. The fan should be placed as far back as possible.

(Continued on page 97)



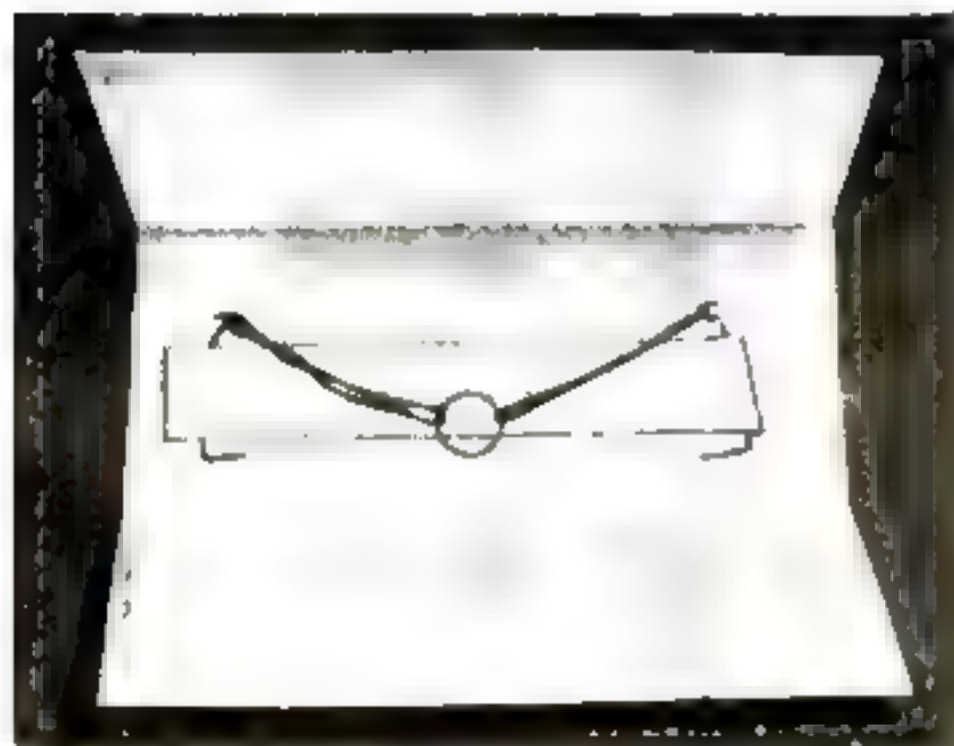
Front and top views of the generator and an end view drawn to a larger scale. There are two identical units in the generator, each consisting of two copper electrodes separated by a thin glass plate



TRICK LETTER BUZZES WHEN UNFOLDED

A FOLDED sheet of letter paper labeled "instructions" and fastened with a paper clip was handed me recently at a party. As I removed the clip and unfolded the letter, a rapid buzzing sound like that of an angry insect made me jump.

The buzzing mechanism, I found, consisted of two fine wire hooks, fastened down as shown by a strip of paper, which had been pasted across the sheet. Two rubber bands were held by the wire hooks, and a wire ring, which joined the bands in the center, had been twisted a number of times before folding the paper.—B. K.

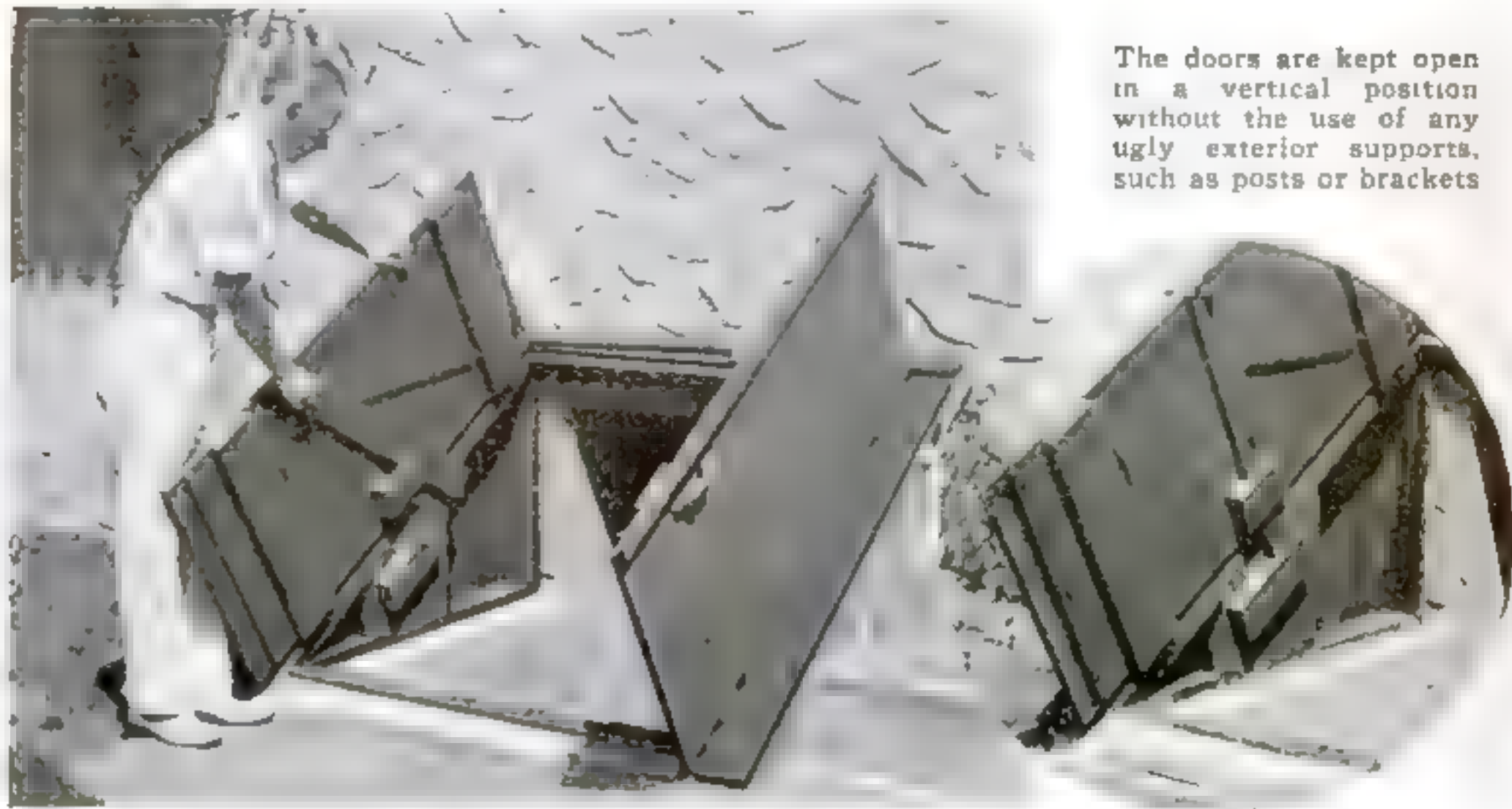


How the buzzer is made. The wire ring is twisted many times before folding the paper

HOLDING CELLAR TRAPDOORS OPEN

OUTSIDE cellar doors of the type illustrated may be held in a vertical position when open by the simple method illustrated. As each door is closed, the lever is swung nearly parallel to the edge, and the

end of the lever is caught under the small wooden dog shown, which is actuated by a spring. A long coil spring holds the lever in position whenever the door is opened.—A. J. VIKEN.



The doors are kept open in a vertical position without the use of any ugly exterior supports, such as posts or brackets

QUICK WAY TO BOLT A BENCH TOGETHER

IN BOLTING together a workbench, the time required to cut the usual oblong holes from the inside face of the stringers for imbedding the nut and washer of each bolt can be saved by making the joints as shown.

A piece of round hardwood about 1½ in. in diameter is ripped through the center to form two half-round pieces. An expansion bit is then set to make a hole of the same diameter, and each hole is bored nearly through the stringer. The bolt hole is bored through the leg and into the end of the stringer until it enters the large hole. A piece of the half-round stock is cut off, equal in length to the depth of the large hole, and held temporarily in position until the bolt hole is continued on through it.

When the bolt is put in place, the metal washer under the nut has a flat contact surface over its entire area, and the tension of the bolt is distributed to the end grain of the stringer by the hardwood piece.—OSCAR SCHWENDT.



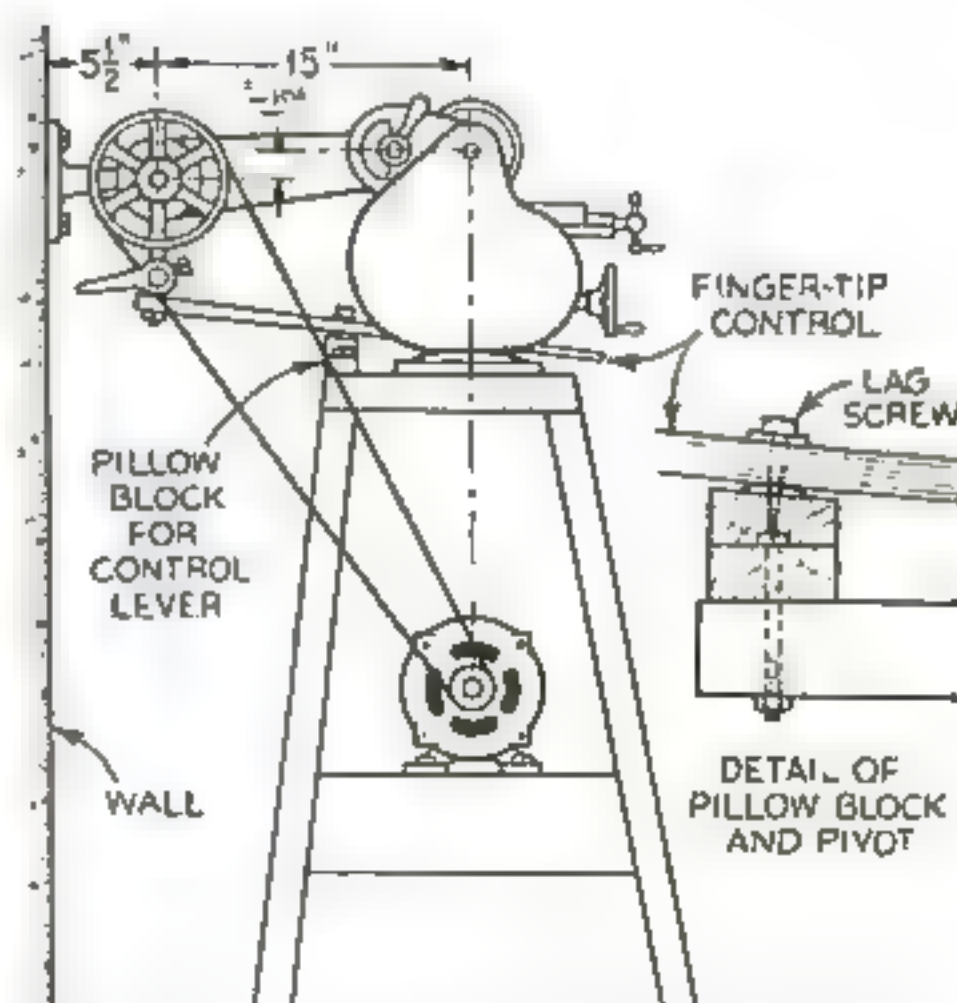
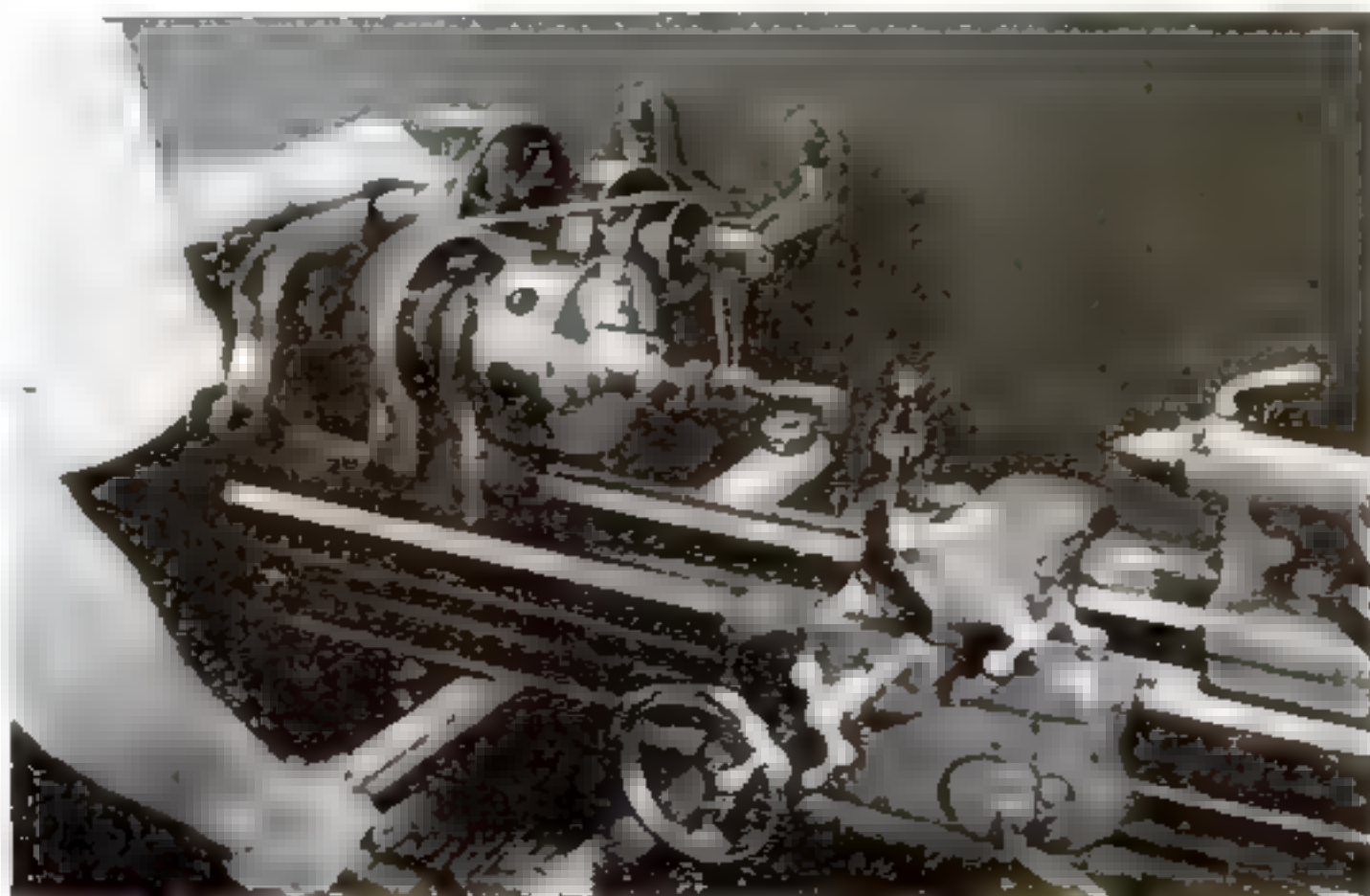
Bolted in this way, the bench is rigid enough to support power-driven machines

Finger-tip Control for Shifting the Belt of a Lathe

WITH only a slight movement of the hand, it is possible to shift the belt of a lathe from tight to loose pulley and back again if the control lever is arranged as shown so that it projects to the front of the lathe. As the lathe is usually set up in front of a wall, the tight-and-loose pulley countershaft may be mounted on the wall; otherwise a bracket or frame may be constructed at the rear of the lathe.

The motor is conveniently placed on the bench-leg braces, but may be mounted at any desired point in line with the countershaft pulley. The belt-shift lever

is pivoted on a lag screw set into a wooden block fastened to the rear of the lathe bench, and it runs back as shown to connect with the finger rod of the countershaft.—G. F. LAMPKIN.



The handle of the lever projects in front, where it may be reached by moving the hand only a short way from the carriage controls. The dimensions are for a small 9-in. lathe

Broomstick Craftwork *and*



The ever-useful broomstick lends itself to countless projects of the type sketched. Left: A whatnot



Below: Turning one piece in a chess set made entirely from broom handles



The knob is turned in a centering chuck.

Checkers may be sawed from a broomstick, sanded, stained, and polished. Carroms may also be sawed if first the crowned edges are turned in the lathe and the center is drilled out. Hard maple broomsticks make excellent stock on which to exert your craftsmanship in making chessmen.

In making the wastebasket, drill and mortise about thirty pieces of broomstick 12 or 14 in. long, as shown. Thread strong cord through the holes. In the top row of holes, thread a child's wooden bead in each space between the sticks. Bring the ends together, thread through the first stick again, draw tight, and measure the diameter across the small end to determine the proper size to which to saw the bottom piece. Insert bottom and tie, as detailed.

A few other self-explaining projects are illustrated, and the field seems without limit. Wooden buttons are now the style, and broomsticks give you a source of supply. Handy little knobs and handles, picture frames, trousers hangers, doll beds and cradles, and many other items may be made.—FRED A. BEARD.

IT GROWS on you—the broomstick habit. First, you plan something that requires a spindle resembling a broomstick; then, before you know it, almost every project will need a dash of broomstick to make it just right.

Broomsticks combine the qualities of strength, even grain, easy workability, and good seasoning. Many of them are not perfectly round, but they can be centered in the lathe, made round, and given whatever additional shaping may be desired.

Drilling through center. Swing the table of your drill press so that the bit does not strike it at the center hole. Drill through the table, and tap the hole so that a machine bolt can be screwed into it from below. Grind a point on the bolt and screw it into place so that it projects about $\frac{1}{2}$ in. above the table. Align the point of the bit and the point of the bolt, and set the depth gauge to a position just past the halfway point on the piece to be drilled.

Find the center at each end of the broomstick with a center finder, and mark with a punch. Place the piece in the drill press with one punch mark on the point of the bolt, and start the drill at the punch mark on the other end, grasping the broomstick tightly as it is being drilled. The capacity of your drill press will be twice the length of your drill.

This drilling operation is required to make beads, carroms, lamps, and many other articles.

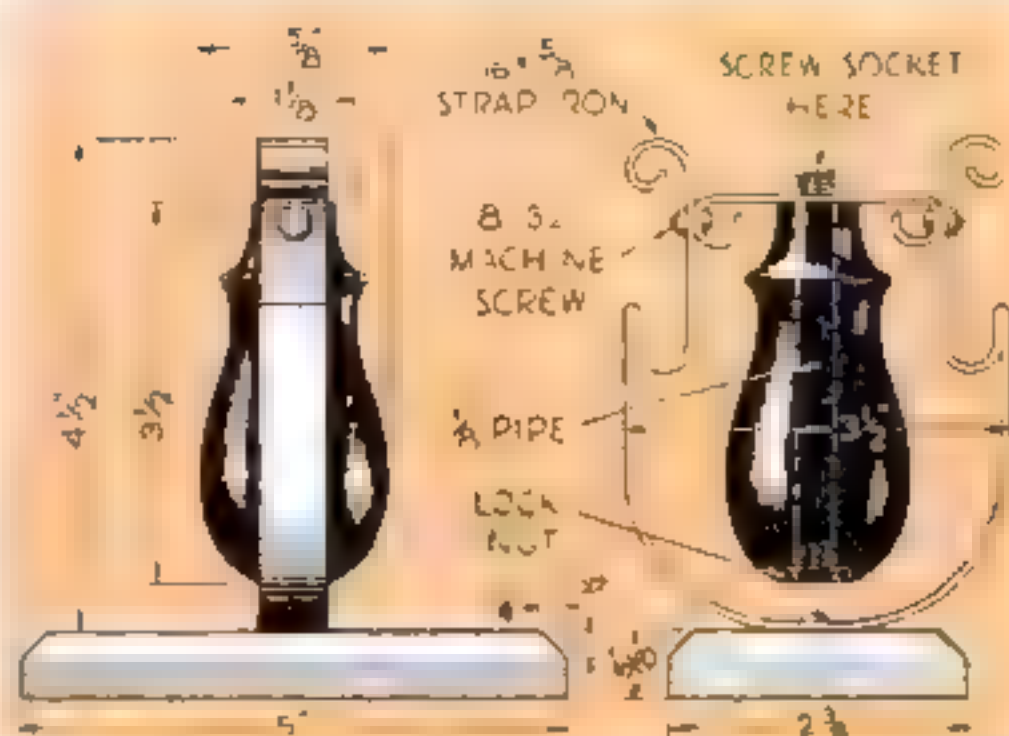
Broomstick projects. The ash tray and panel-door decoration show how broomsticks may be adapted to modern trends in design. The cane is formed by holding the stick firmly against a sanding drum, after first locating and marking the positions.

Other Short-Order Novelties

SMALL LAMP SERVES DOUBLE PURPOSE

DESIGNED to stand on a desk or hang on the wall, this attractive lamp serves two purposes. Use mahogany, walnut, or other cabinet wood for the base, which is $\frac{5}{8}$ by $2\frac{3}{4}$ by 5 in., and the turned piece, which is made from a block $1\frac{3}{4}$ in. square and $3\frac{1}{2}$ in. long. Bore a hole through the latter, drive a dowel in each end, and turn and sand the piece. Remove the dowels and insert a piece of $\frac{1}{8}$ -in. pipe $3\frac{3}{4}$ in. long and threaded at both ends.

A piece of strap iron $\frac{1}{16}$ by $\frac{5}{8}$ in. and 16 in. long is required for the main metal frame, and a similar piece $4\frac{1}{2}$ in. long for the crosspiece. Drill a $\frac{3}{8}$ -in. hole in the center of the shorter piece, and $\frac{5}{32}$ -in. holes for machine screws; then bend the pieces as shown and assemble. Finish the wood with stain and varnish



Side and end views of the lamp as it appears in its normal position for use on desk, table, or night stand

or with clear lacquer. Use black enamel or lacquer on the metal parts. Sand lightly with 4/0 or finer sandpaper. The final step is to attach the cord and add the bulb and a small shade.—W. W. SCOTT.



A slanting hole is drilled part way into the back of the base near one end so that the lamp may be hung

UNIQUE BOOK ENDS WIN \$50 PRIZE

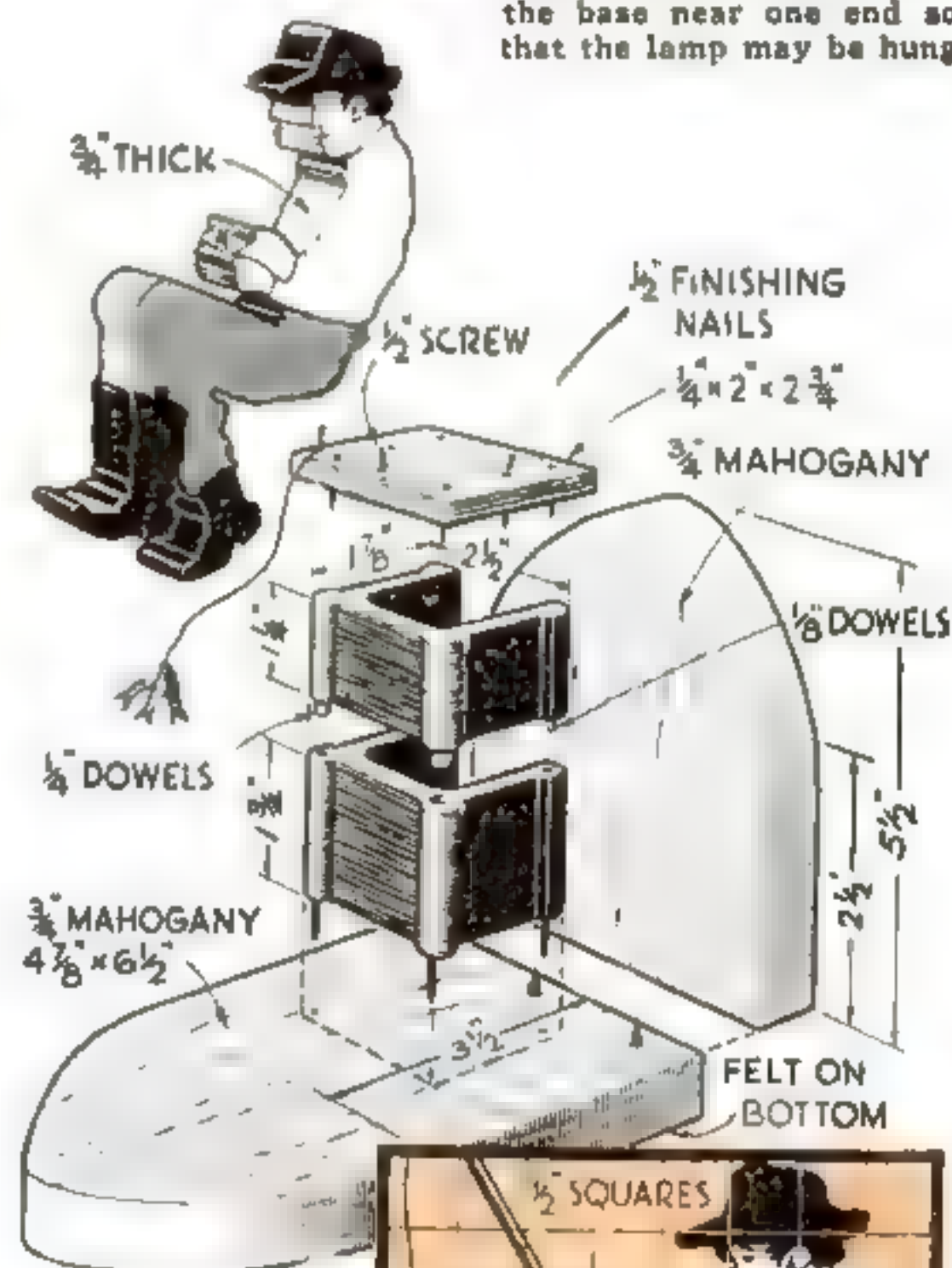
FROM materials costing less than a dollar, these novelty book ends can be made in an evening, except for the painting and finishing. They come apart as shown below so that cigarettes can be stored in one end and a lighter in the other. The project was submitted by the Premier Homeworkshop Club, of Chicago, Ill., in a recent contest of the National Homeworkshop Guild and won the \$50 first prize (see page 82).

To make the book ends, you need 1 sq. ft. of $\frac{3}{4}$ -in. mahogany for the backs and bottoms, 1 piece of any $\frac{3}{4}$ -in. wood about 7 by 7 in. for the two figures, a 6-in. piece of "2 by 4" for the "docks," a $\frac{1}{4}$ -in. dowel 12 in. long, 4 in. of $\frac{3}{4}$ -in. dowel, six $1\frac{1}{8}$ -in. screws, two $\frac{1}{2}$ -in.

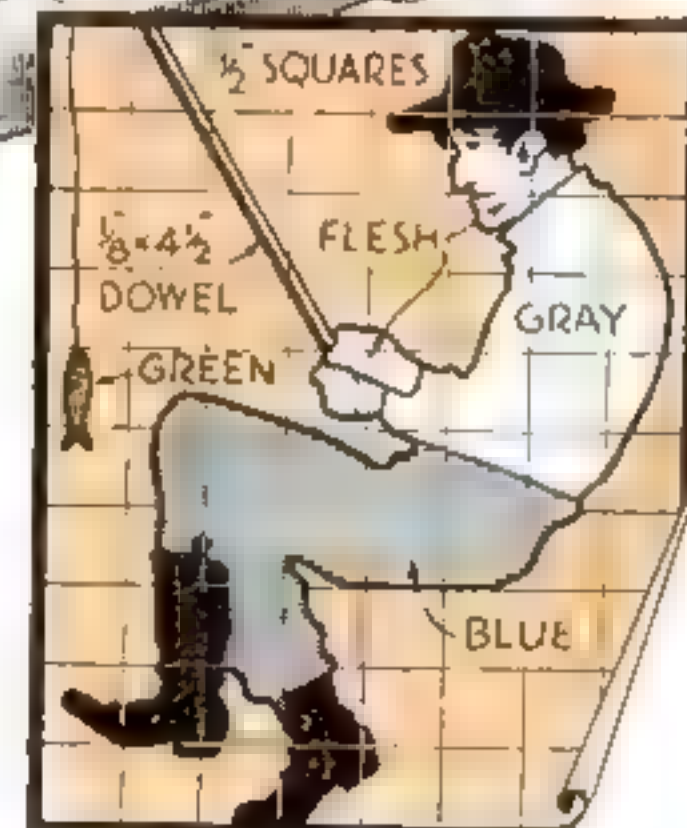
screws, eight $1\frac{1}{2}$ -in. finishing nails, and fourteen $\frac{1}{2}$ -in. finishing nails.

Lay out a full-size pattern of the fisherman and jig-saw two figures. Shape the outside of the "docks" while they are in a single length; then cut the block in half and drill four holes more than halfway through each for the registering dowels. One block can then be sawed out to hold cigarettes, and the other bored and chiseled or sawed out to receive whatever type of lighter is to be used. Finally each piece is sawed apart to form the upper and lower section.

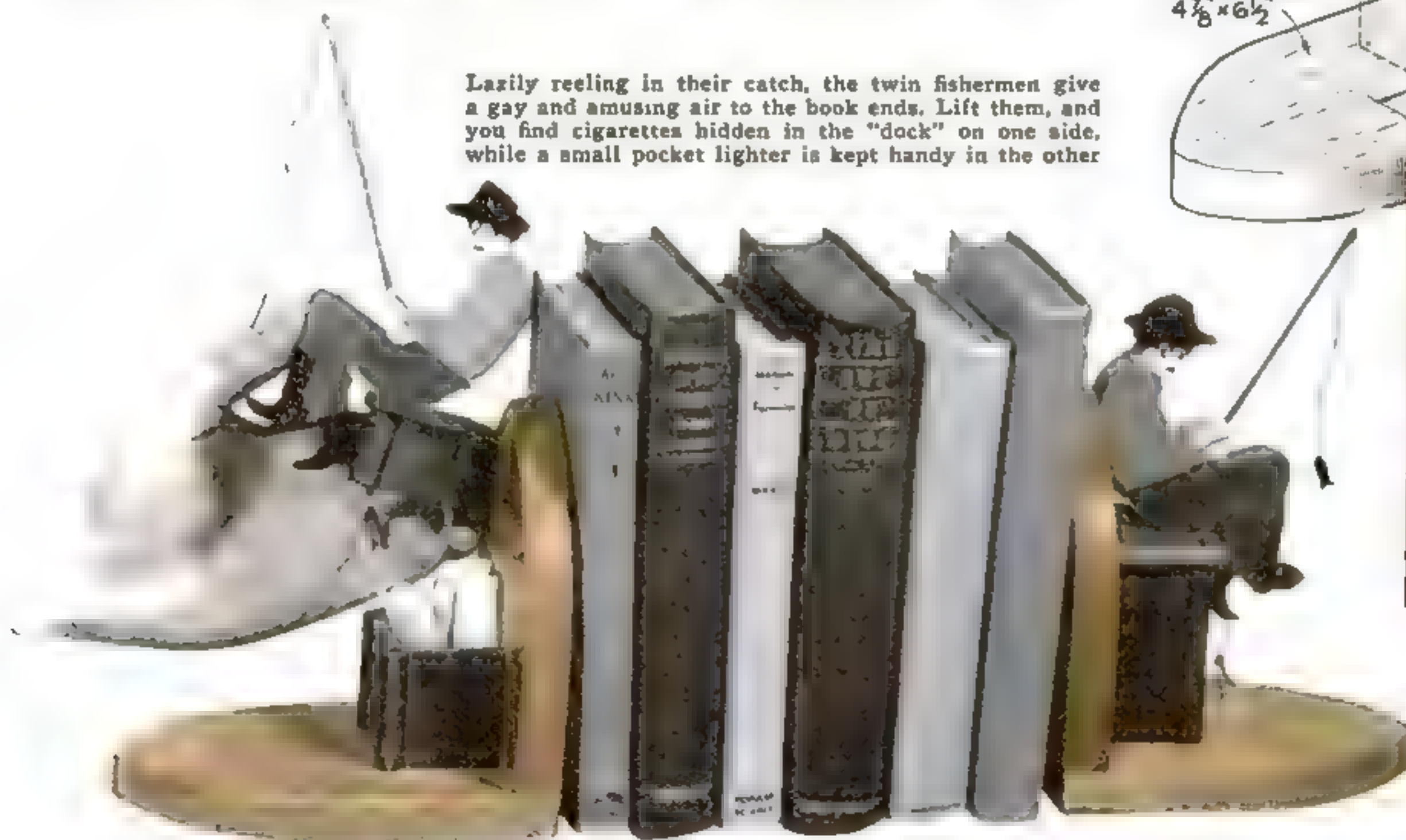
The remainder of the construction is made clear in the drawings.



Lazily reeling in their catch, the twin fishermen give a gay and amusing air to the book ends. Lift them, and you find cigarettes hidden in the "dock" on one side, while a small pocket lighter is kept handy in the other



A pattern for laying out and painting the fishermen and, above, how book ends and "docks" are made





Three-hour project contest brings out wide variety of fine craftwork. . . All entries had to be of original design and made from raw materials costing less than one dollar

Judges examine some of the entries submitted by Guild clubs



Eight Guild Clubs Win Prizes

ENTRIES submitted in the recent National Homeworkshop Guild contest sponsored by POPULAR SCIENCE MONTHLY (see P.S.M., Dec. '36, p. 67) showed a consistently high standard of craftsmanship. First prize was won by the Premier Homeworkshop Club, Chicago, Ill., for a pair of novelty book ends described in detail elsewhere in this issue. Drawings and photographs of the other winning projects will be given in succeeding issues.

To be eligible, each project had to be made within three hours, not including time for gluing or finishing, and from materials costing one dollar or less. Because of the ingenuity and fine workmanship displayed, the judges awarded a special sterling silver medal in addition to the seven announced prizes and gave honorable mention to fourteen clubs. Many types of home workshop activities were represented, including woodworking, metal working, wrought-iron work, model making, and leathercraft.

The announcement of the contest last December resulted in several new clubs being formed, and two or three of these

succeeded in gaining honorable mention for their entries. The Guild recognizes as a club any group of five or more persons at least sixteen years old who will hold meetings at least once a month and agree to abide by the Guild's simple rules. No charge is made for any of the Guild's services.

"The home workshop movement is not, and shall not be, a selfish hobby," is the slogan adopted by the *Jacksonville (Fla.)* Homeworkshop Club, and the members attribute the club's growth and success to it. Recently a member discovered that Negro boys at a detention camp were without any equipment to keep their minds occupied. It was found that their director had been a manual training instructor and could help the boys if he had tools. A. P. Meredith, president, issued a call for donations of tools, and the results were most satisfactory because not only hand tools but power equipment were sent in. Lumber companies assisted by supplying scrap lumber.

The club has already started work on articles to be auctioned next Christmas for the bene- (Continued on page 98)

WINNERS

In Three-Hour Project Contest

FIRST PRIZE, \$50

Premier Homeworkshop Club, Chicago, Ill., for pair of novelty book ends.

SECOND PRIZE, \$25

Edmundston (N. B., Canada) Hobbyists, for tie rack.

THIRD PRIZE, \$15

New Bedford (Mass.) Woodcraft Club, for playing-cards box.

FOURTH PRIZE, \$10

Fairmont (W. Va.) Homecraft Club, for ash tray.

FIFTH PRIZE, A PLAQUE

Le Roy (N. Y.) Homeworkshop Club, for wooden bowl inlaid with lead.

SIXTH PRIZE, A PLAQUE

Billings (Mont.) Homeworkshop, for leather name plate.

SEVENTH PRIZE, A PLAQUE

Capital Homecraft Club, Washington, D. C., for bathroom stool.

SPECIAL CRAFTWORK MEDAL

Fargo (N. Dak.) Homecraft Guild, for inlaid walking cane.

HONORABLE MENTION

Bison Homeworkshop Club, Buffalo, N. Y.; Brockton (Mass.) Homecraft Club; Club des Artisans Amateurs, Trois Rivières, P. Q., Canada; Erie (Pa.) Homeworkshop Guild; Homecraft and Modelmaker's Guild, Richmond, Va.; Homeworkshop Club of Meridian, N. Y.; Hyattsville (Md.) Woodworking Club; Mexico (Mo.) Homeworkshop Club; Nampa (Idaho) Homecraft Guild; Peekskill (N. Y.) Homeworkshop Club; Pittsfield (Me.) Craftsmen's Homeworkshop Club; Rockford (Ill.) Homecraft Club; Southside Homeworkshop Club, Argo, Ill.; Wood-Ridge (N. J.) Homeworkshop Club.

Solid Scale Model of the Famous Hawks Racing Plane

'Time Flies'

By
DONALD W. CLARK

BECAUSE it is equipped with complete flight and engine instruments and an automatic pilot, the latest Frank Hawks speed plane *Time Flies* is known as the world's "biggest little ship." It has the dependability of a modern transport plane and a maximum speed of 375 m.p.h.—a record-breaking combination.

Time Flies is a semi low-wing cantilever monoplane designed by Hawks and Howell Miller. The specifications are: Span, 31 ft.; length, 22 ft.; height, 8 ft. 6 in.; wing area, 160 sq. ft.; cruising speed, 340 m.p.h.; landing speed (with flaps), 65-68 m.p.h.; rate of climb, 7,000 ft. per minute;

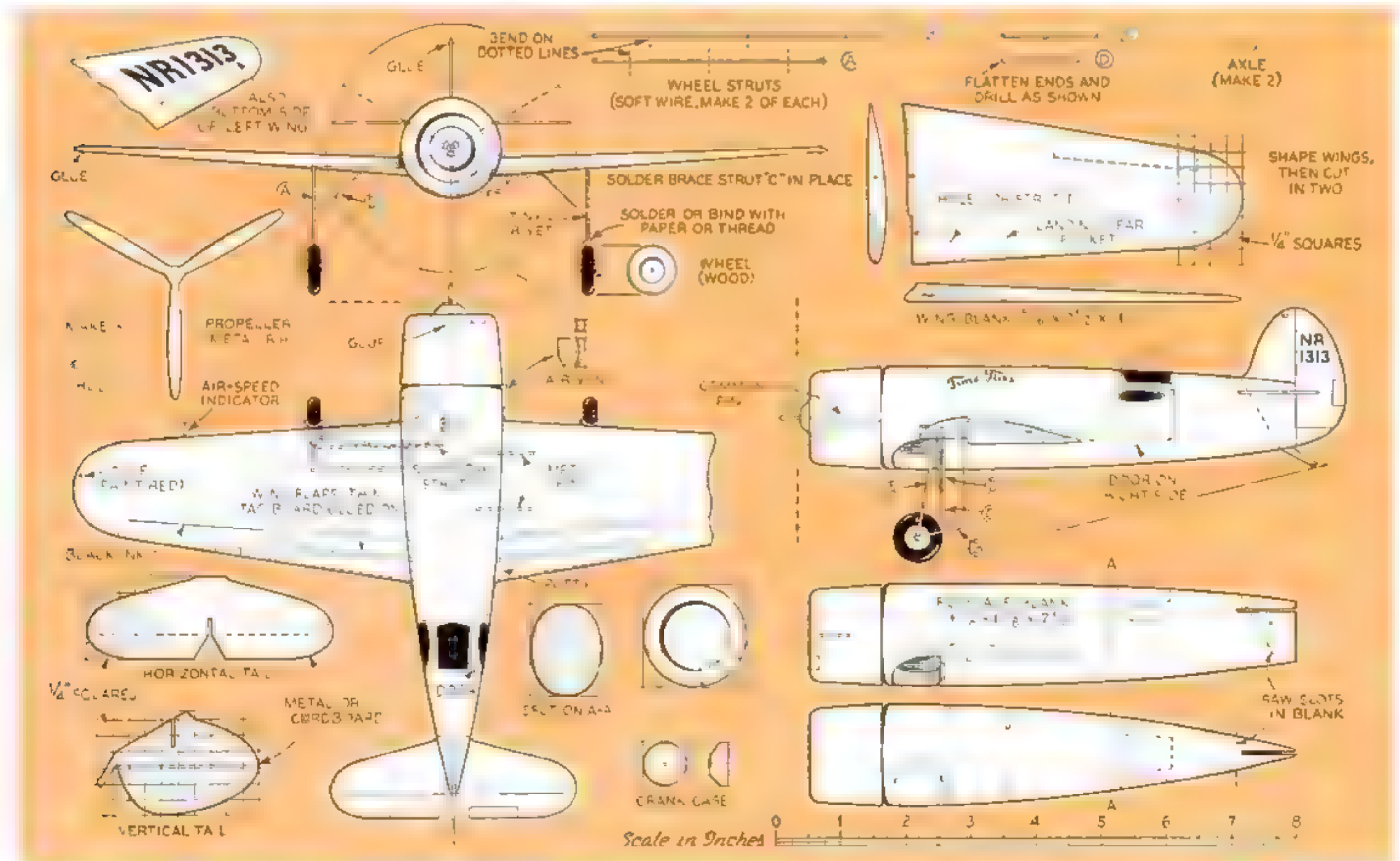
cruising range, 1,700 miles; engine, twin Wasp, 1,150 h.p.

The model is built to our customary scale of $\frac{3}{8}$ in. equals 1 ft. The landing gear folds into the wings and fuselage as on the real ship. By tilting the gear outward a bit, strut *D* can be released, and this will allow the wheel and mount to swing into its pocket, where it is held by friction. The struts can be made of soft

wire. Small nails or pin points serve as the fulcrums or pivot points.

The real plane has a movable windshield that is raised or lowered with the seat by means of a hydraulic jack. It is raised for a take-off or landing, lowered for flying.

The entire plane is painted cream color, with black windows, cowl recess, tires, hinge lines, and markings.



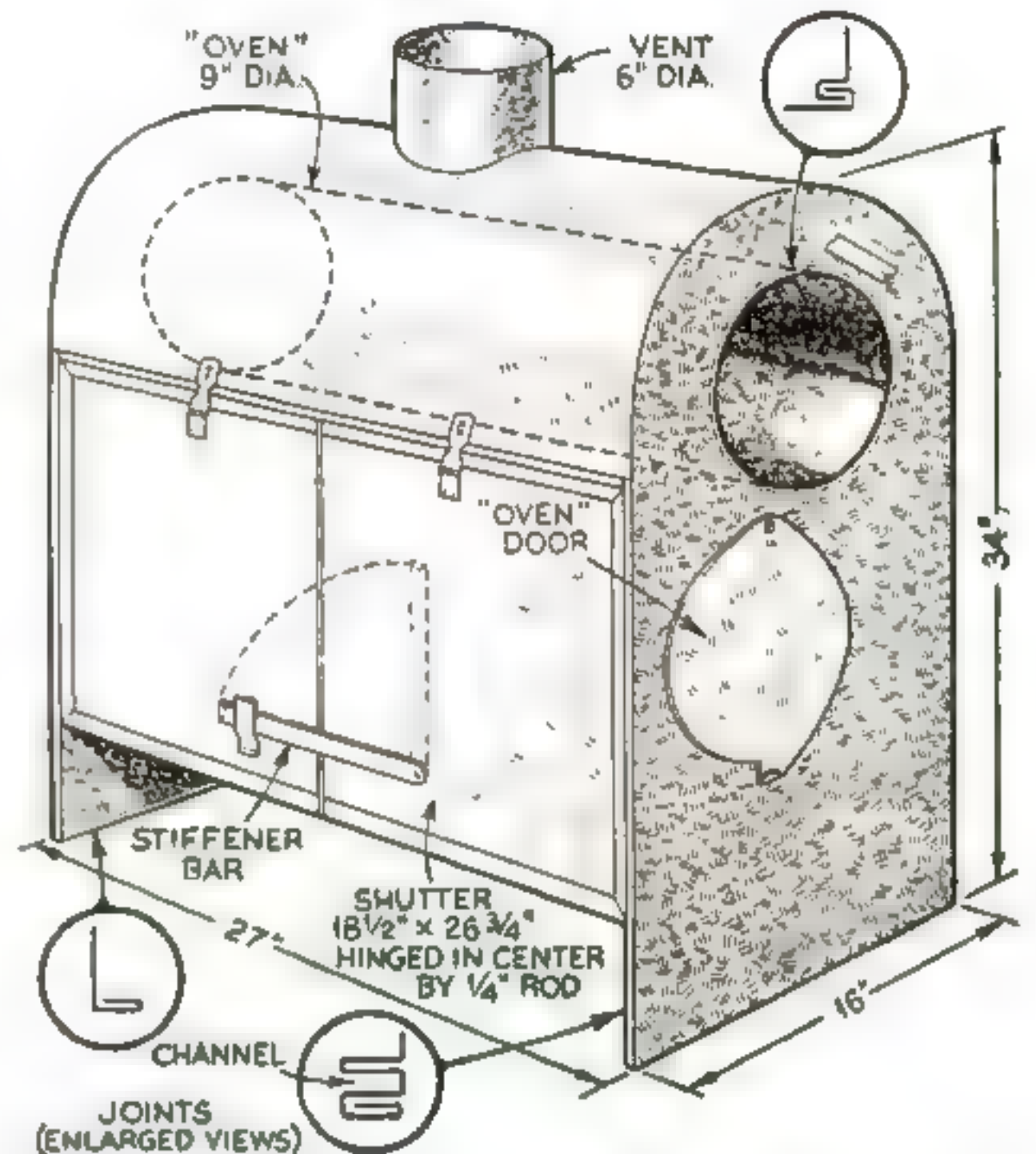
Three views of the assembled model and details of the principal parts. Mr. Clark recommends clear white pine for making the fuselage and wings

IMPROVED Trailer Fittings

MAKE LIFE ON WHEELS
MORE COMFORTABLE



This stove canopy rids a trailer of most cooking odors and gas fumes. When the main doors are closed and the "oven" opened, it becomes an efficient heater



EVERY amateur trailer builder incorporates into his home on wheels various inexpensive conveniences to make it more livable and comfortable. Many ideas for fittings and accessories were submitted in our recent trailer contest, and here are seven suggestions that won prizes*:

Stove Canopy. The canopy illustrated, according to its designer, Harold P. Ryken, will get rid of most of the cooking odors and gas fumes from the trailer stove, and when the weather is chilly, it can easily be converted into a heater. The material is 26-gauge galvanized or black iron.

To use as a heater, the front shutter is slipped into the side channels and then up into the upper channel. The 9-in. tube near the top of the canopy is for additional heating surface and can be used for warming small dishes when the "oven" doors are closed. If this feature is omitted, some expense may be saved and the canopy will gain slightly in efficiency, but more than 5 sq. ft. of heating surface is lost. The vent should run straight up, and the collar may have to be placed off center in order to avoid a ceiling joist. Install a 6-in. damper in the collar and a ventilator on the roof. In most cases the canopy will have to be made in a sheet-metal shop.

Water System and Sink. Water tanks built in trailers are often hard to clean, so Charles A. Prescott devised the sanitary and inexpensive gravity water system and sink shown. Obtain an older type oil-stove reservoir that

will fit into the corner. Use it as a pattern, and attach a $\frac{1}{2}$ by $\frac{1}{2}$ -in. round piece of wood on the bottom; then have a bronze casting made. Drill and tap the bottom piece for a $\frac{1}{4}$ -in. pipe, but be careful not to drill through into the reservoir. Screw the flange at the other end to the table as shown so that the pipe supports the 3-gal. bottle. Locate center of reservoir; then drill and tap for $\frac{3}{8}$ -in. fittings for copper tubing to supply water to the sink faucet.



An enamel dishpan serves as a sink, and the water is carried in an easily cleaned bottle

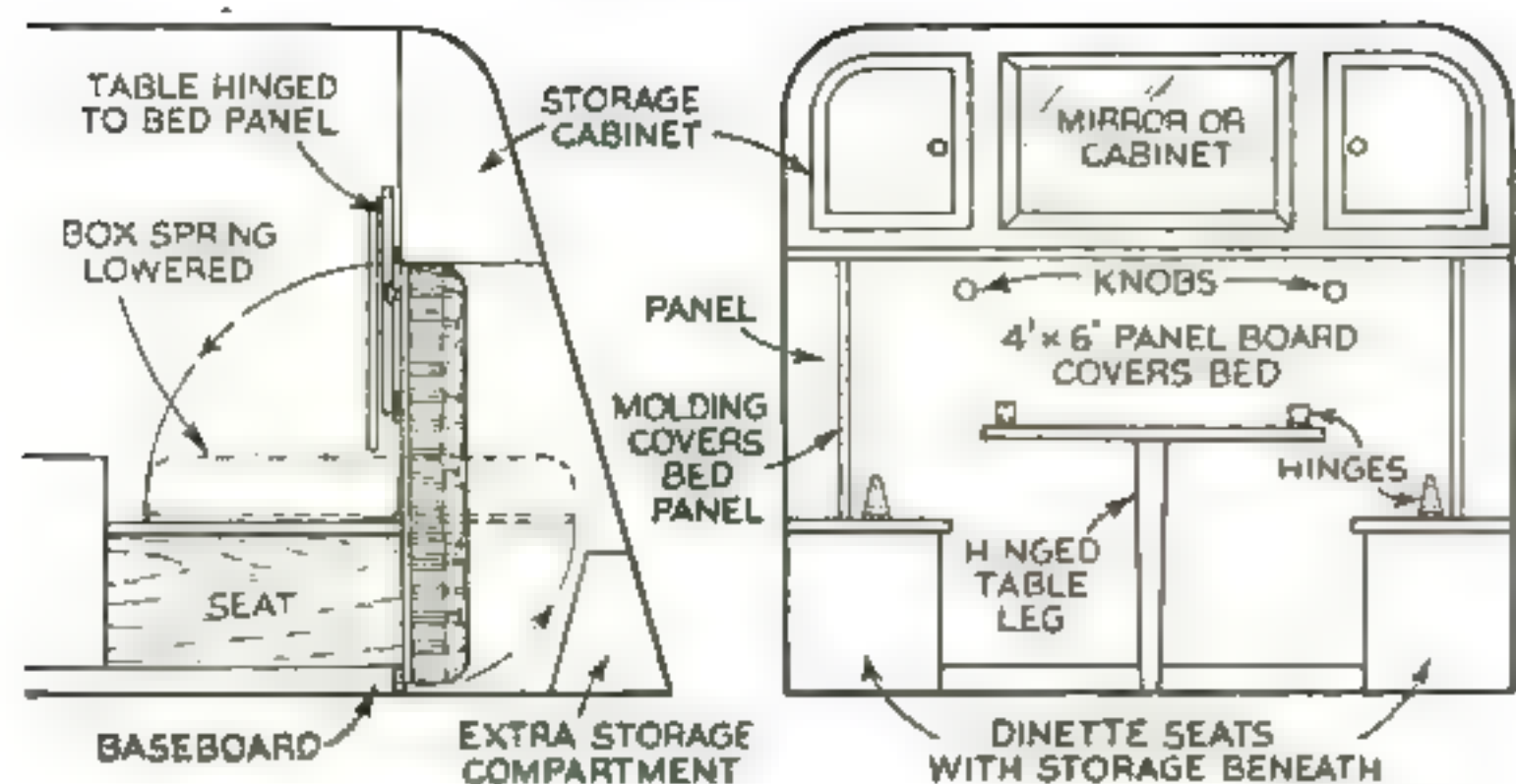
There is usually a hole on the back of the reservoir. Make a small bracket with a stud to fit the hole and fasten to the corner of the trailer with screws. Place a metal strap around the bottle and fasten to the trailer.

The sink consists of an enamel oblong dishpan about 5 by 11½ by 16 in. Drill the bottom for a 2-in. sink strainer, which usually comes complete with washer, flanges, and nut. Attach a brass tube from the strainer through the trailer floor. Chromium plating of all metal parts adds to the attractiveness of the installation.

Door Pocket. Made with a strap-iron frame covered with imitation leather to match the finish of the interior, the roomy pocket shown has been used satisfactorily as a laundry container on the doors of several trailers, according to Kenneth Murray. Solder hinges to the bottom of the frame, attaching them to the lower part of the inside of the



*For complete list of prize winners, see P.S.M., May '37, p. 87.



Suggested arrangement for a bed. The table can be folded flat and the bed tipped down, where it is held securely with catches

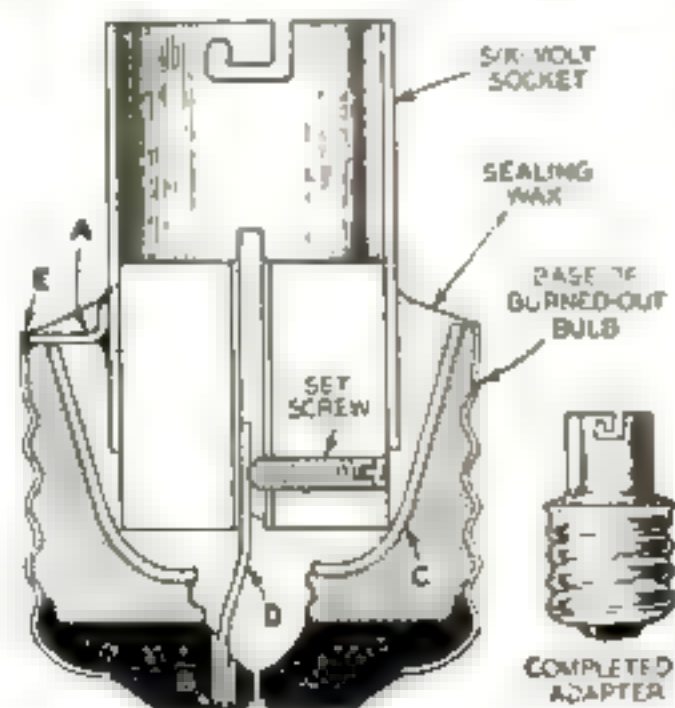
trailer door as shown on preceding page.

Bedding Arrangement. When the trailer is small and space is limited, it may be possible to work out a table and bed arrangement such as that used by John Wells and shown in the drawings above. The box spring or mattress is attached on the bottom to plywood, or whatever type of panel board was used on the inside of the trailer, and fastened to each breakfast-seat box with hinges so it can be let down to lie flat on the seat cushions. Bedding is fastened to the mattress with large safety pins. When the bed is swung into the storage space, the table can be brought down into position.

Socket Adapter. A. P. Fletcher won a prize with a homemade socket adapter that enables both 6- and 110-volt bulbs to be used in the 110-volt electric sockets so that the trailer needs only one set of wiring for city electric current and storage battery current from the car.

The base of a burned-out bulb, a battery bulb socket, two short pieces of 18-gauge bare copper wire, sealing wax, and solder are the materials needed. Break away all the glass from the base except the lower part C, which is held by sealing wax. Drill a 3/32-in. diameter hole B through the contact disk, off center about 1/8 in. so that the curled flanges which hold the disk in place are not cut away. Secure the center wire D in place by the set screw of the 6-volt bulb socket, and solder the wire A to the outer shell. Place the socket into the screw base as nearly central as possible, and solder the wires at B and E. Warm the entire assembly and pour sealing wax into the space between the 6-volt socket and the screw base.

Trailer Jack. With materials costing less than a dollar, D. C. Marshall built a rolling adjustable jack—a necessary accessory for almost every trailer. The materials needed are a pipe tee, two pipe plugs, a long nipple, a pipe cap, two iron wheels such as are used on hand trucks, and a screw. A bench screw or one from an old organ stool will serve.



A 6-volt adapter that can be screwed in a 110-volt socket

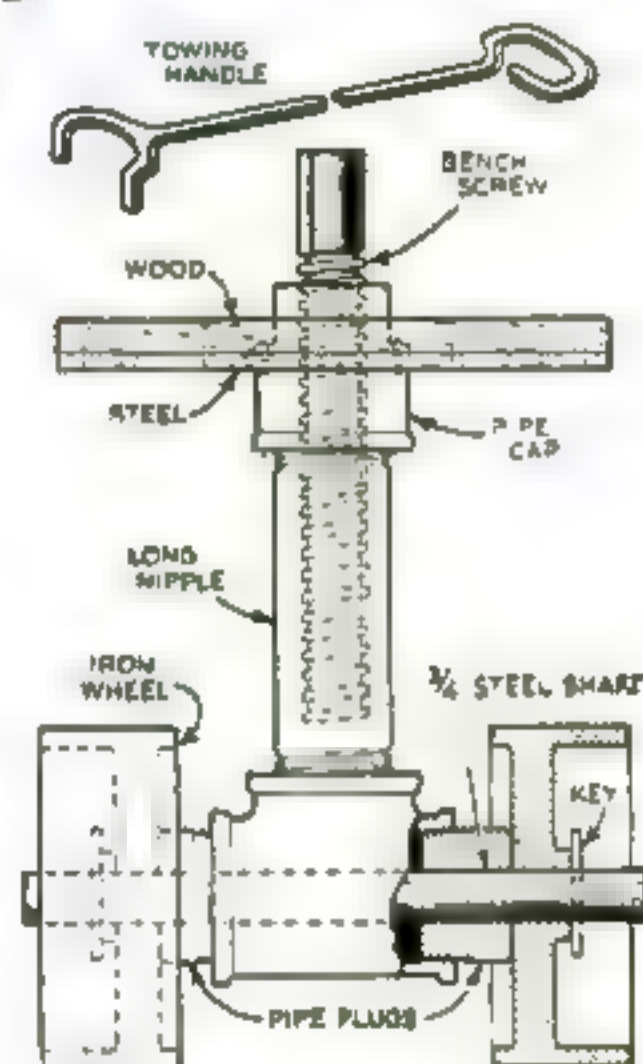
If a bench screw is used, take off the tee on the end and, if necessary, cut off the other end to get the proper length. Take the threaded bushing and fit a flat piece of bar steel to it with rivets through the screw holes on the bushing. It should be about 8 in. long so it will make an easily turned handle. Fit a piece of wood on the top side of this steel to give it enough thickness for a handle. Drill a hole through the center of the steel plate so the screw will pass through freely.

A hole of the same size is bored through the center of the pipe cap, and then the pipe fittings are assembled as shown in the drawing. The pipe should be at least 1 1/4 in. or larger for heavy trailers. To prevent the screw from wobbling about in the nipple, make a lining, which can be a smaller piece of pipe or a piece of wood turned to fit inside the pipe and with a hole bored lengthwise through the center.

The square ends of the pipe plugs are sawed off after they are in place, and holes drilled through each for the axle. The latter consists of a piece of steel shafting with a hole in each end for a cotter key. A washer on each side of the wheel will allow it to turn more easily.

A socket is attached to the trailer frame near the front to fit the top end of the jack screw. The handle for pulling the trailer up to the car when ready to hitch has two prongs, which must be strong enough not to bend. They are riveted or welded to the handle or tongue. The tongue is attached by hooking these prongs over the ends of the tee so that the center part

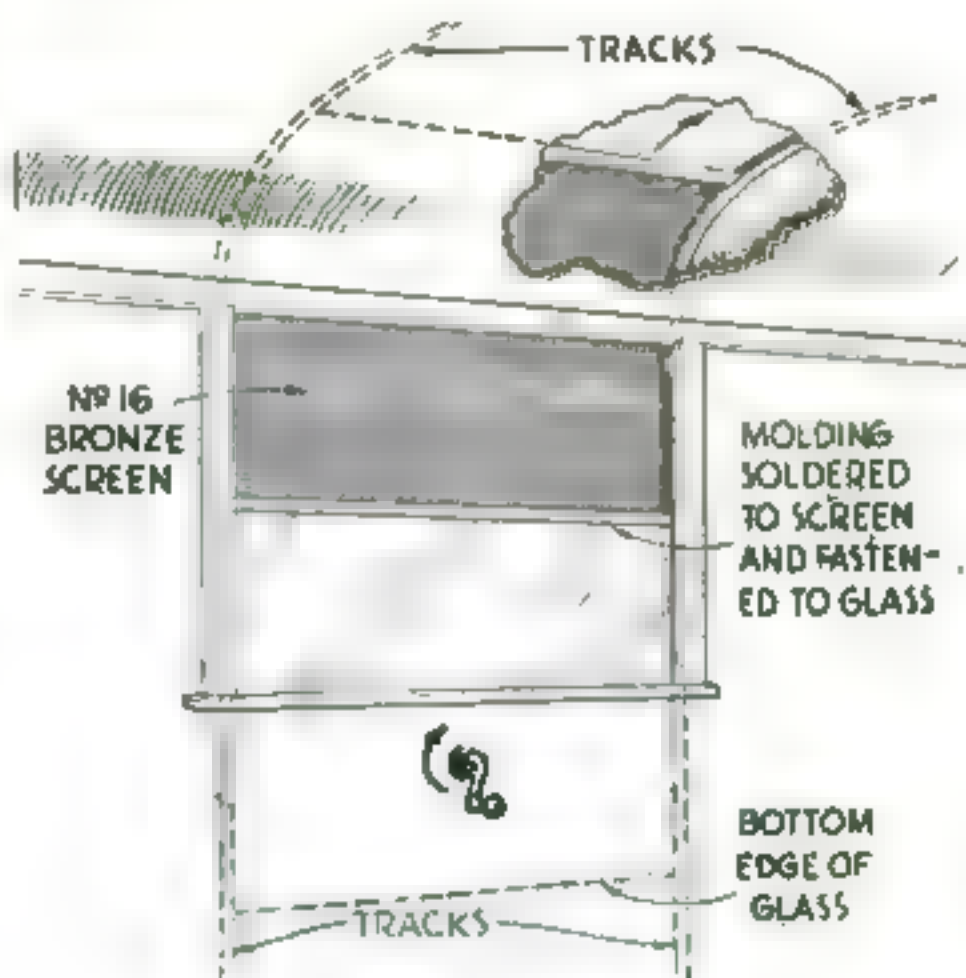
Except when used, the bed is hidden behind the wall panel, which is hinged to the top of the table seats



Homemade jack mounted on wheels. The top fits into a socket on the trailer frame

of the tongue rests against the upright branch of the tee.

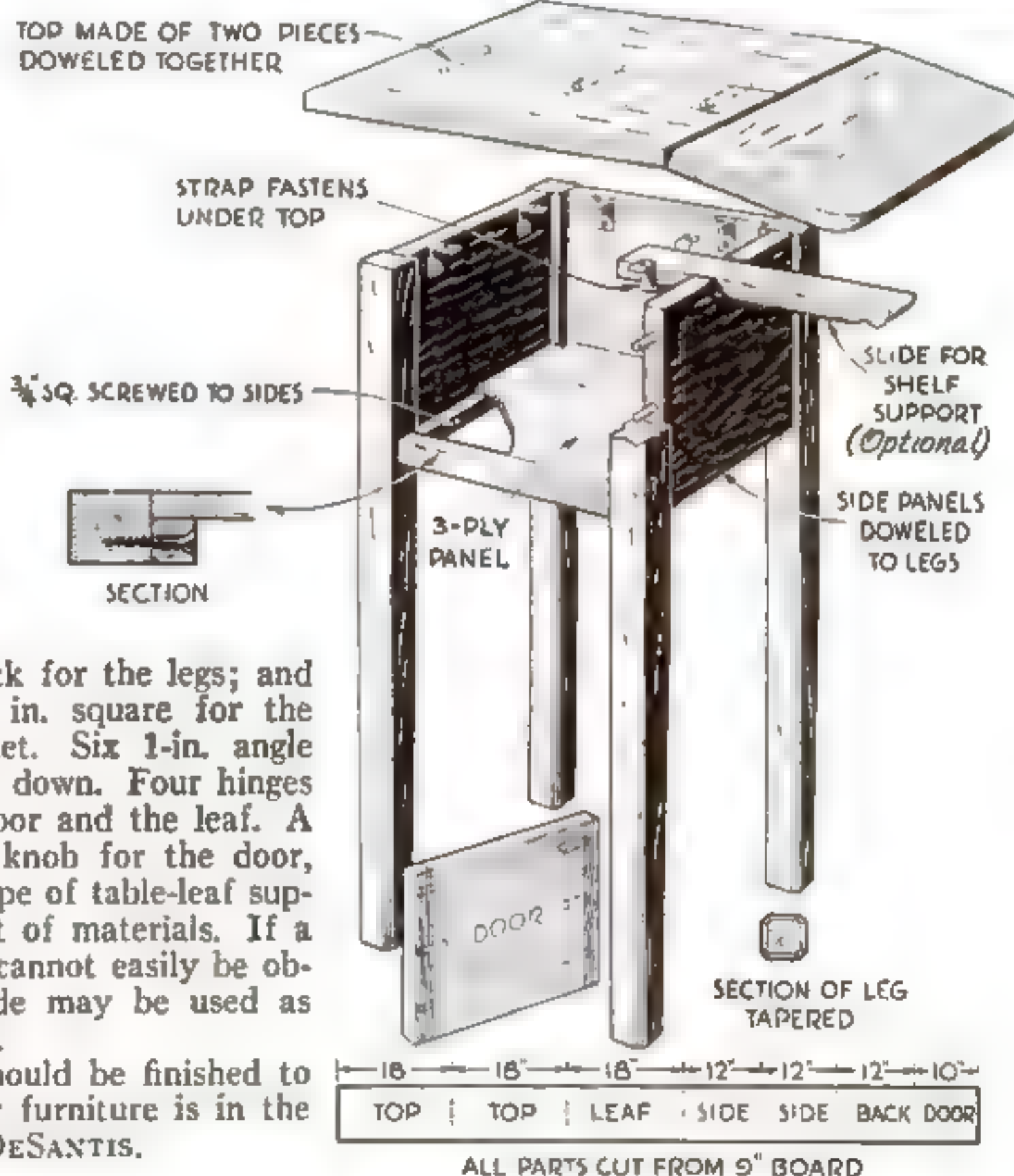
Combination Screen and Window. If the trailer has a rounded roof and auto-type windows are installed, it is possible in some trailers to attach the screen to the top of the window as shown. Fred W. Vogel points out that there are many advantages to such a combination.



An auto-type window combined with a screen, which slides up around the curve of the roof

Seven Prize-Winning Ideas for Accessories That Are Inexpensive to Make and Install

Combined Table and Cabinet for Electric Mixer



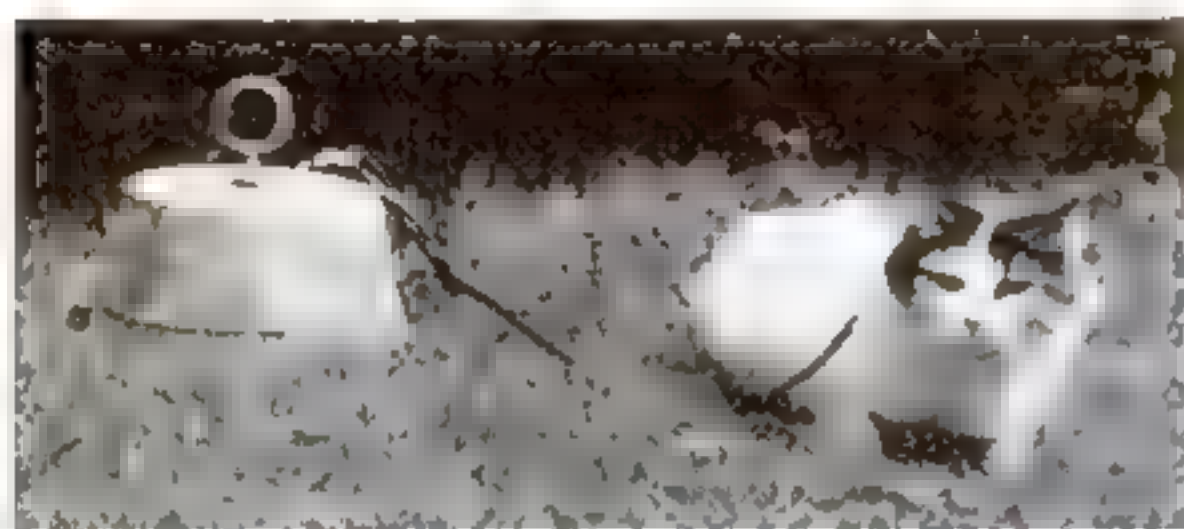
FOR only two dollars you can build this compact table-cabinet for an electric mixer and all its accessories.

The height of the table should be made to suit the housewife, and the cabinet should be large enough to receive the mixer bowls, juice extractors, and the like. The cabinet illustrated was made 33 in. high with a top 18 in. square. When the leaf is raised, the top becomes 18 by 27 in. and provides additional working space.

The following material was used: a board $\frac{7}{8}$ by 9 in. by 9 ft. of clear pine for the top, sides, door, and leaf; 12 ft.

of $1\frac{1}{2}$ -in. square stock for the legs; and a plywood panel 12 in. square for the bottom of the cabinet. Six 1-in. angle brackets hold the top down. Four hinges are needed for the door and the leaf. A friction catch and a knob for the door, and a snap-bracket type of table-leaf support complete the list of materials. If a suitable leaf support cannot easily be obtained, a wooden slide may be used as shown in the drawing.

The entire piece should be finished to match whatever other furniture is in the kitchen.—MICHELE DESANTIS.

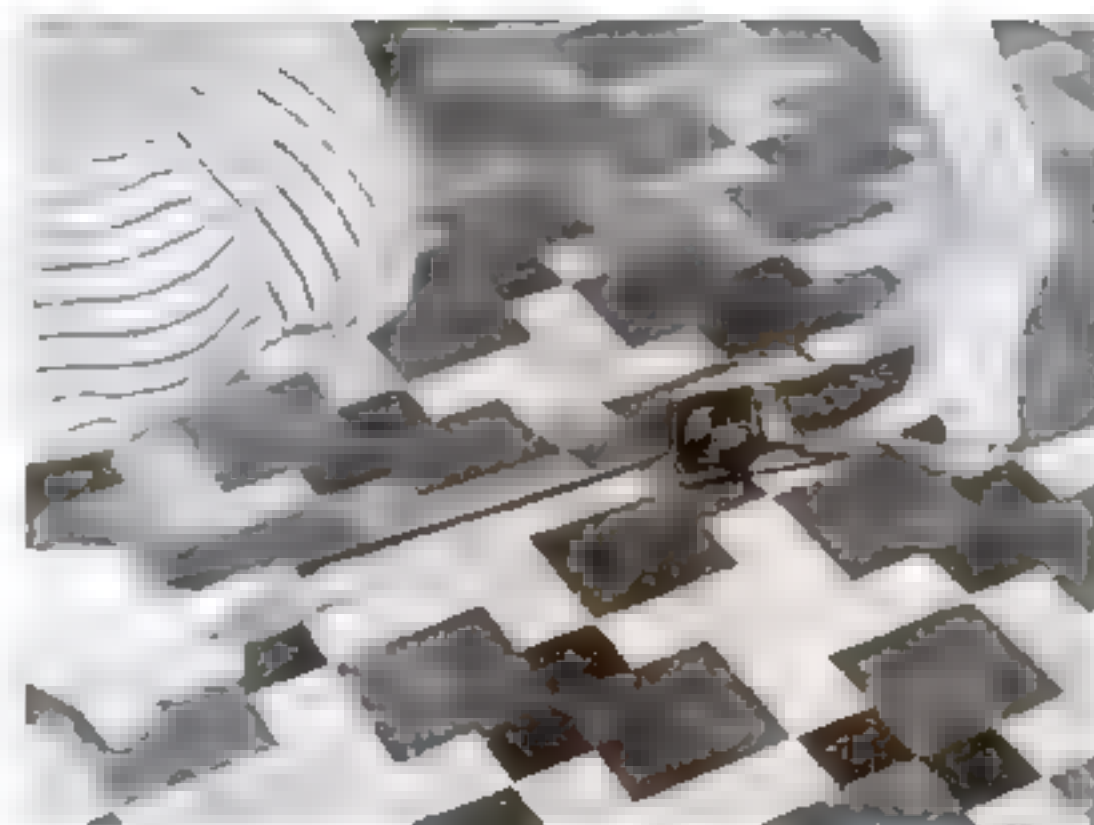


ANCHOR FOR TYING UP PET

THE most comfortable spot in the yard can be chosen for tying up a pet cat or dog with this movable weight or anchor. A ring bolt is inserted through a hole in the bottom of an old tin pan, a nut and washer are added, and the pan is filled with concrete. Later, the tin is ripped off. To prevent the leash from winding on the bolt, a swivel is bent from heavy wire.—A. J. V.

FLOOR COVERING TRIMMED WITH PLANE

ANY floor covering of the linoleum type, if not properly cemented down, is likely to expand after a time and cause the joints to buckle up. Instead of attempting to trim the edges with a knife, use a small, sharp block plane, which will not remove too much material at once. With this method, the floor covering may be fitted very easily and quickly by anyone, as shown in the illustration at the right.—R. O. LISSAMAN.



To safeguard against cutting off too much material, a small plane is used when fitting edges of linoleum

NEW PLUG-IN Arc-Welding Outfit

The welding transformer. All the six coils are in place, and the remaining core laminations are being inserted



How to mount the transformer and make a reactance coil for regulating the output

ONCE the transformer for your plug-in arc-welding outfit has been wound as described last month (P.S.M., June '37, p. 69), the remainder of the work is comparatively simple. It is necessary to mount the transformer, make the connections, and provide a reactance coil for regulating the output.

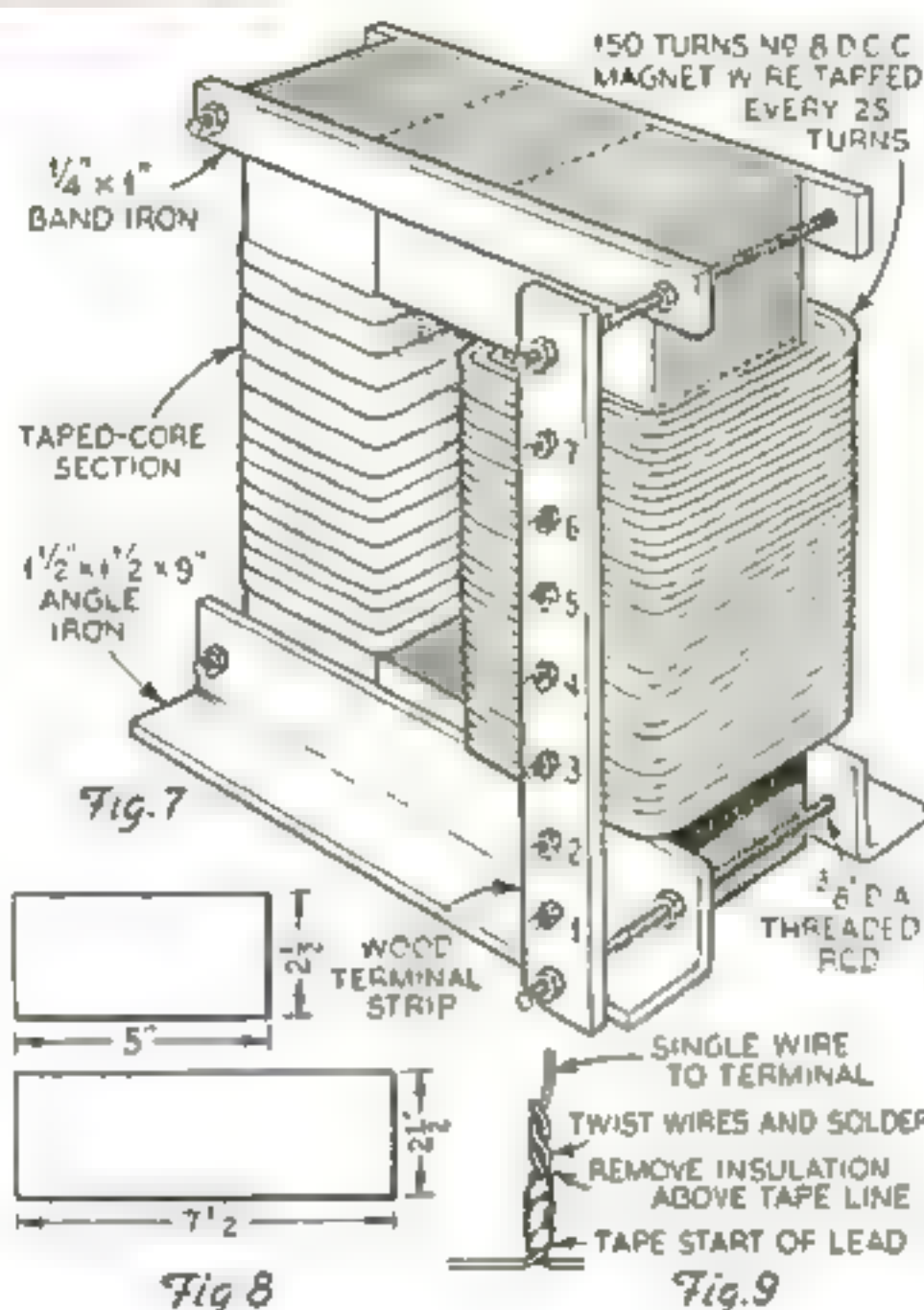
Four pieces of $1\frac{1}{2}$ -in. angle iron, 12 in. long, and four $\frac{3}{8}$ -in. tie rods are required to clamp the core of the transformer. The length of the rods will depend upon the thickness of the top board of the transformer, but should not exceed 9 in. A wood or fiber top, which may be from $\frac{1}{4}$ to 1 in. thick, should be used to protect the terminals from short circuits.

Provide wood spacers between the angle irons and clamp together over the core ends, as shown in the drawing marked Fig. 5 in last month's article. Make terminal strips to fit over the tie bolts, with terminal screws as indicated in the same drawing and illustrated in three photographs on this page. Four $\frac{1}{4}$ -in. brass machine screws will be required for the primary terminals, and eight for the secondary terminals.

The secondary terminals are in two groups, with the four terminals of each group bridged together with strips of No. 20 gauge copper, $\frac{3}{4}$ in. wide. The leads from the secondary coils should be arranged in two groups, the starting leads in one group and the end leads in the other. Connect the starting leads to the terminal screws marked 1 on the diagram of connections (Fig. 4, last month), and the end leads to the terminal screws marked 2.

The primary coils are connected exactly as shown in Fig. 4 because that arrangement enables the coils to be connected in parallel for 110 volts or in series for 220 volts. It is essential that the coils be placed on the core so that their windings are in the proper direction and that they be connected as indicated, otherwise the currents flowing in the coils will not be in opposition and the transformer will not function.

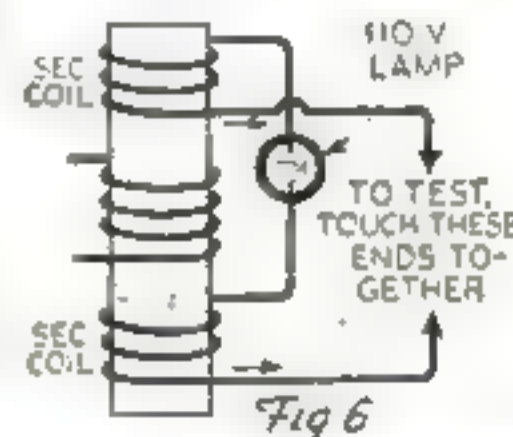
If the builder is in doubt as to the correctness of his connections, he may make the simple test shown in Fig. 6. With the secondary coils connected in parallel, no current will flow between similar ends of the coils due to the fact that the current flows to or from the terminals of all coils at the same instant. Where the connections of a coil are reversed, current will flow from one coil into another because the



current set up in one coil is in the opposite direction, with respect to the terminals, to the current set up in the other coil.

To test the coil connections, leave the ends of the secondary coils free and connect one primary to a 110-volt line. Connect a lamp to the starting leads of two coils, and touch the remaining two leads together. If the lamp fails to light, the leads are correct and may be connected to the proper terminals. If the lamp lights, it indicates that a starting and an end lead have been reversed.

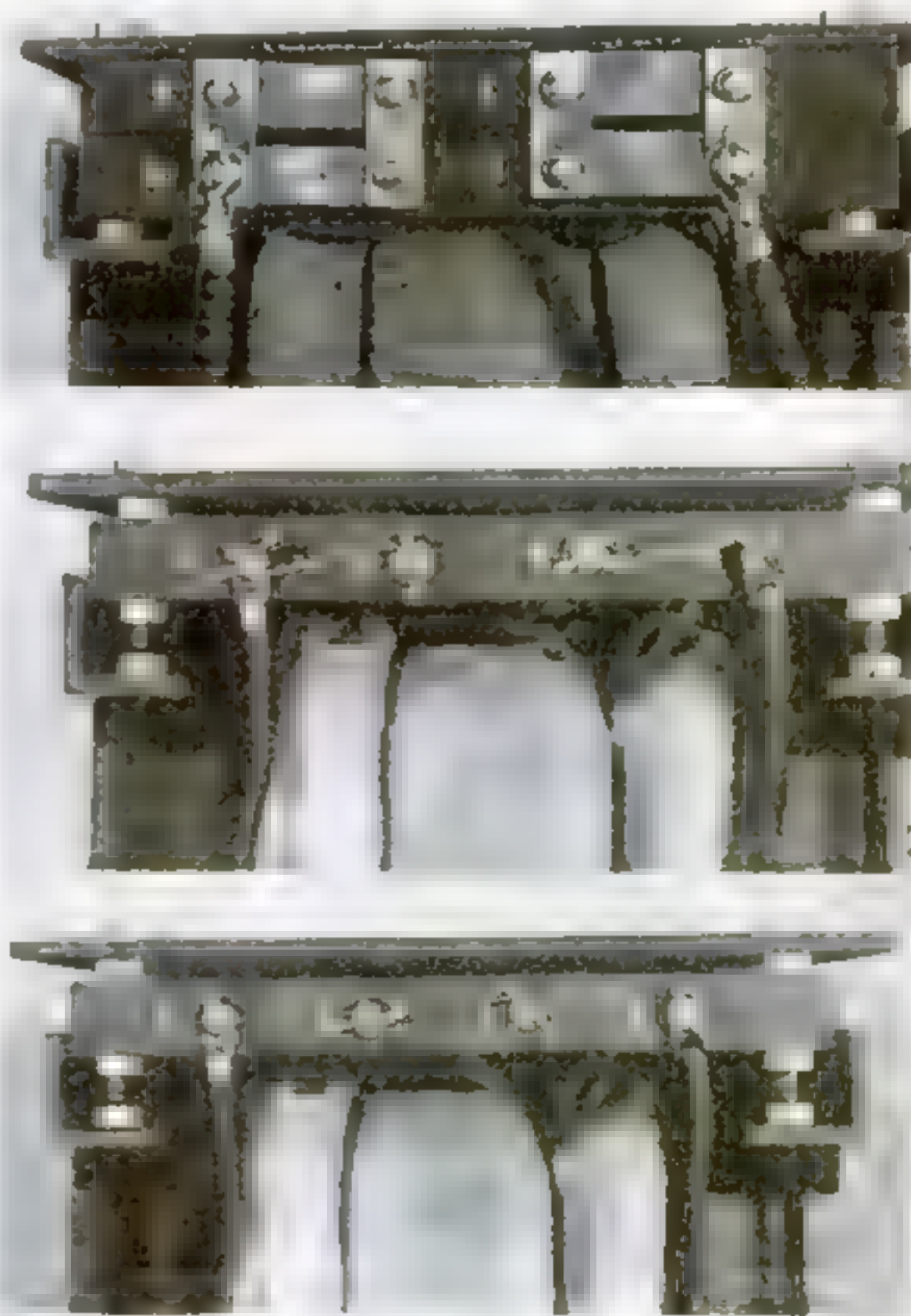
On an incorrect connection the combined voltage of two coils, or 140 volts, will flow (Continued on page 100)



The reactance coil and a method of testing the transformer windings are shown at left



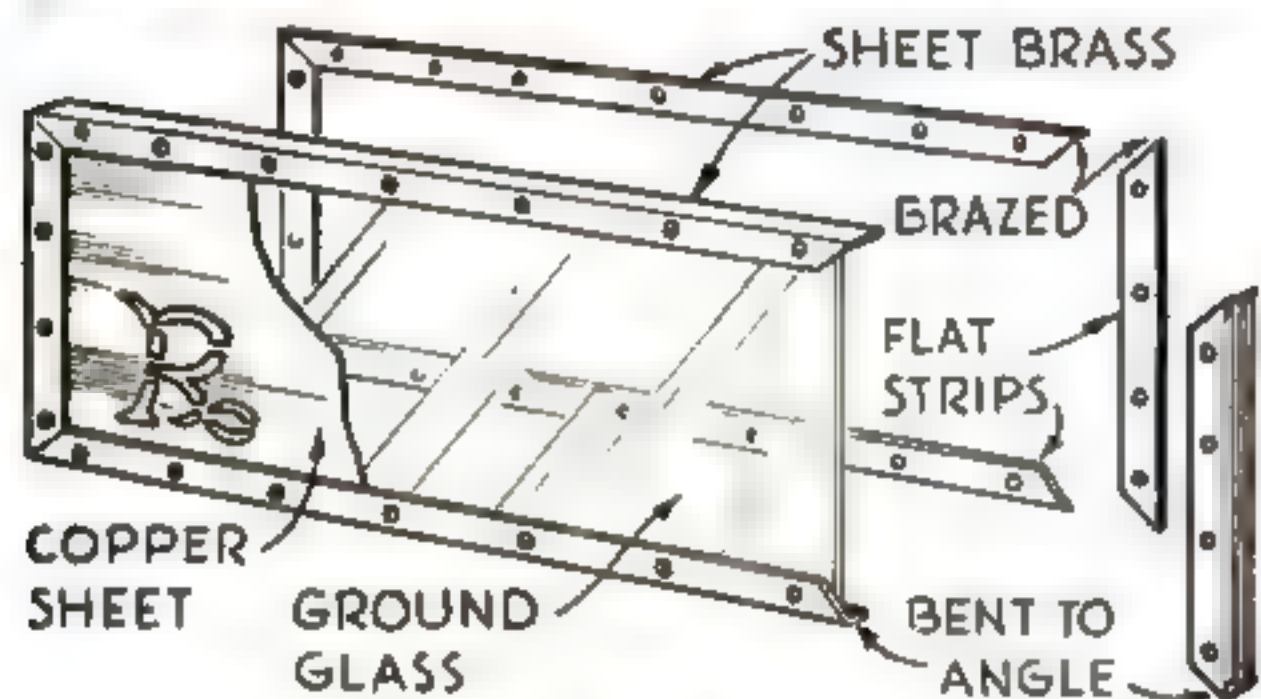
The complete reactance coil, which is tapped every twenty-five turns



At top: Secondary terminal strip of the transformer. Center: Primary terminal strip as connected for 110 volts. Bottom: For 220 volts. Left: Making a splice

Picturesque Signs

DESIGNED TO CATCH THE EYE



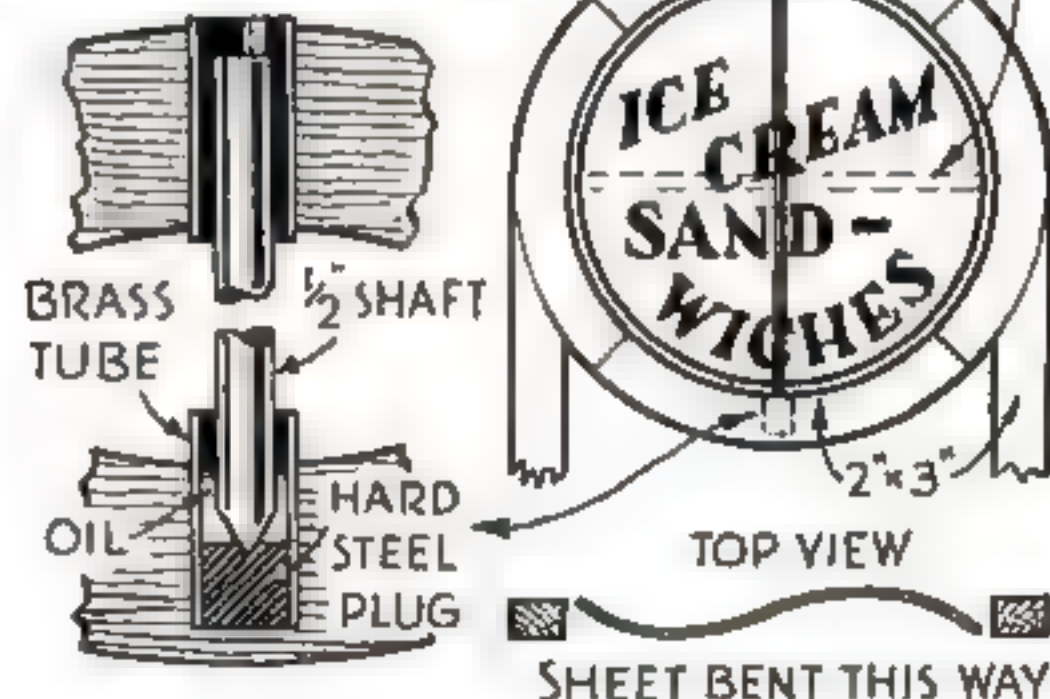
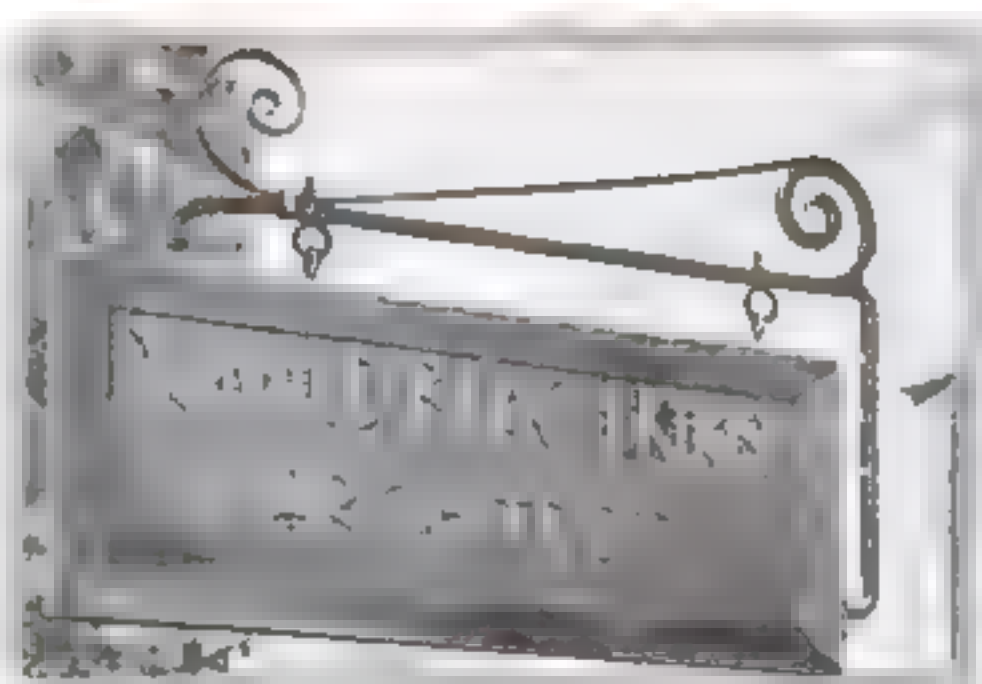
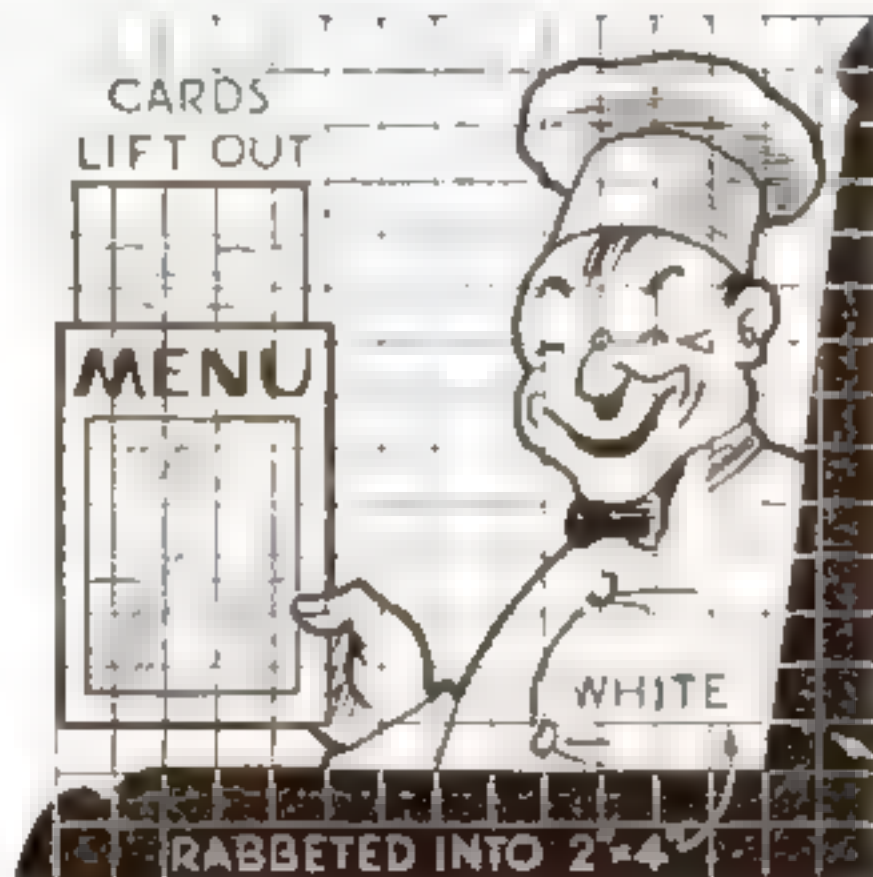
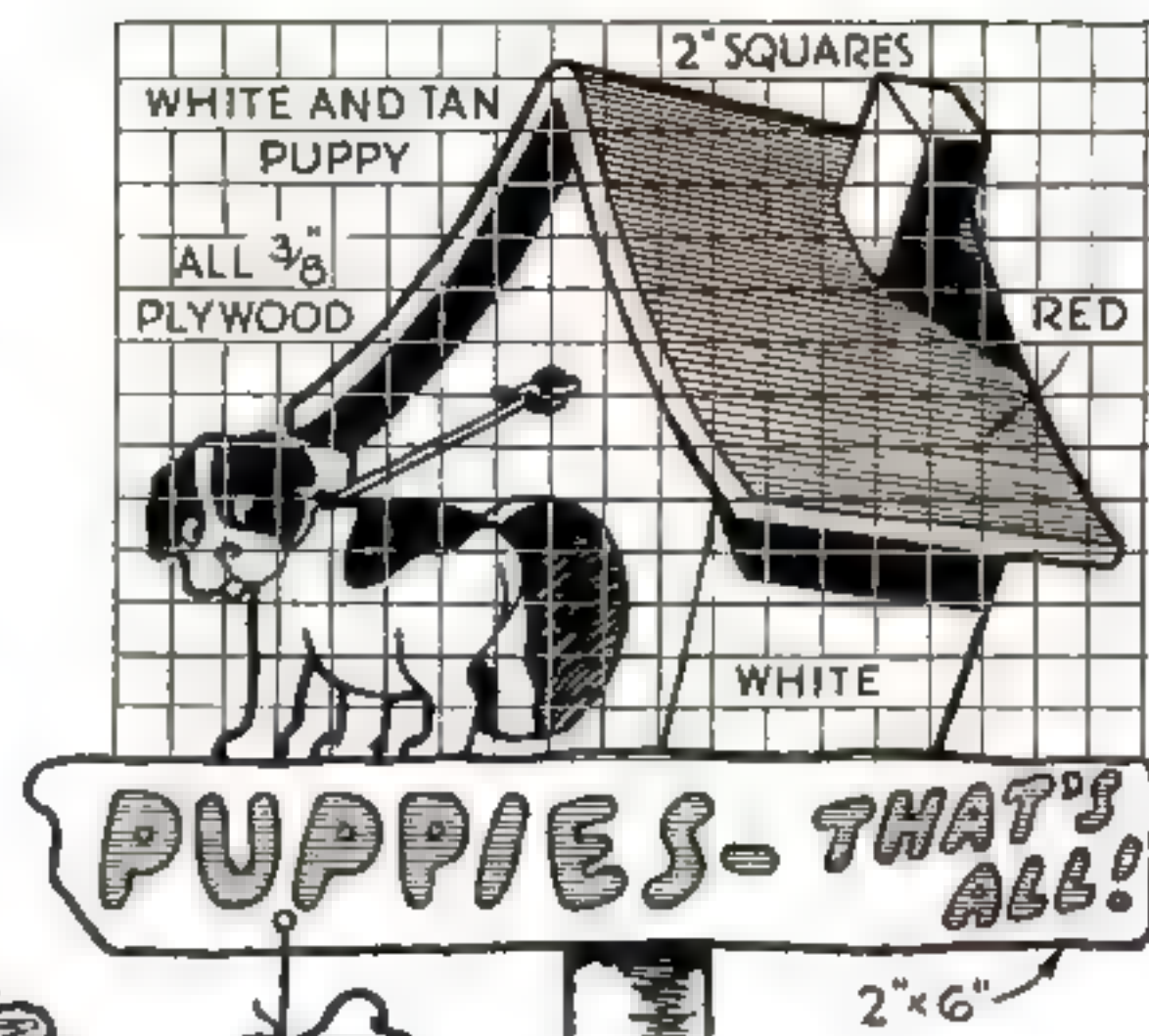
A cut-out metal sign backed with ground glass, and seven other equally novel ideas

SUGGESTIONS for a variety of decorative modern signs are given in the accompanying illustrations.

Signs in brass and copper like the one above lettered "Casa Reposado" can be adapted to a wide range of uses. The lettering is cut with a cold chisel in sheet copper, the work being laid flat on an upended block of hardwood.

A sure-fire attention getter for anything nautical is a large wooden anchor in aluminum finish on a white post, surmounted by a ship's lantern. Another idea for the shore or wherever the sea is to be suggested is to use a conventional wooden sign but form the letters from bits of cotton rope.

The puppy sign in the upper right-hand corner is merely a plywood silhouette rabbeted into a 2 by 6-in. plank and mounted on a 7-ft. post. The chef also is a silhouette, painted the same on both sides. The menu card slips between glass panes in a frame.—H. SIBLEY.



BOTTLE-HOLDING RACK FOR BABIES

A BOTTLE holder like that illustrated simplifies the feeding of babies, particularly twins or triplets. For twins, the shelf should be about 30 in. long. It is 3 1/2 in. wide and supported at an angle by two end pieces that are 10 in. high at the highest point. The spread of the legs is 8 in. Two slots are cut into the front edge of the shelf to

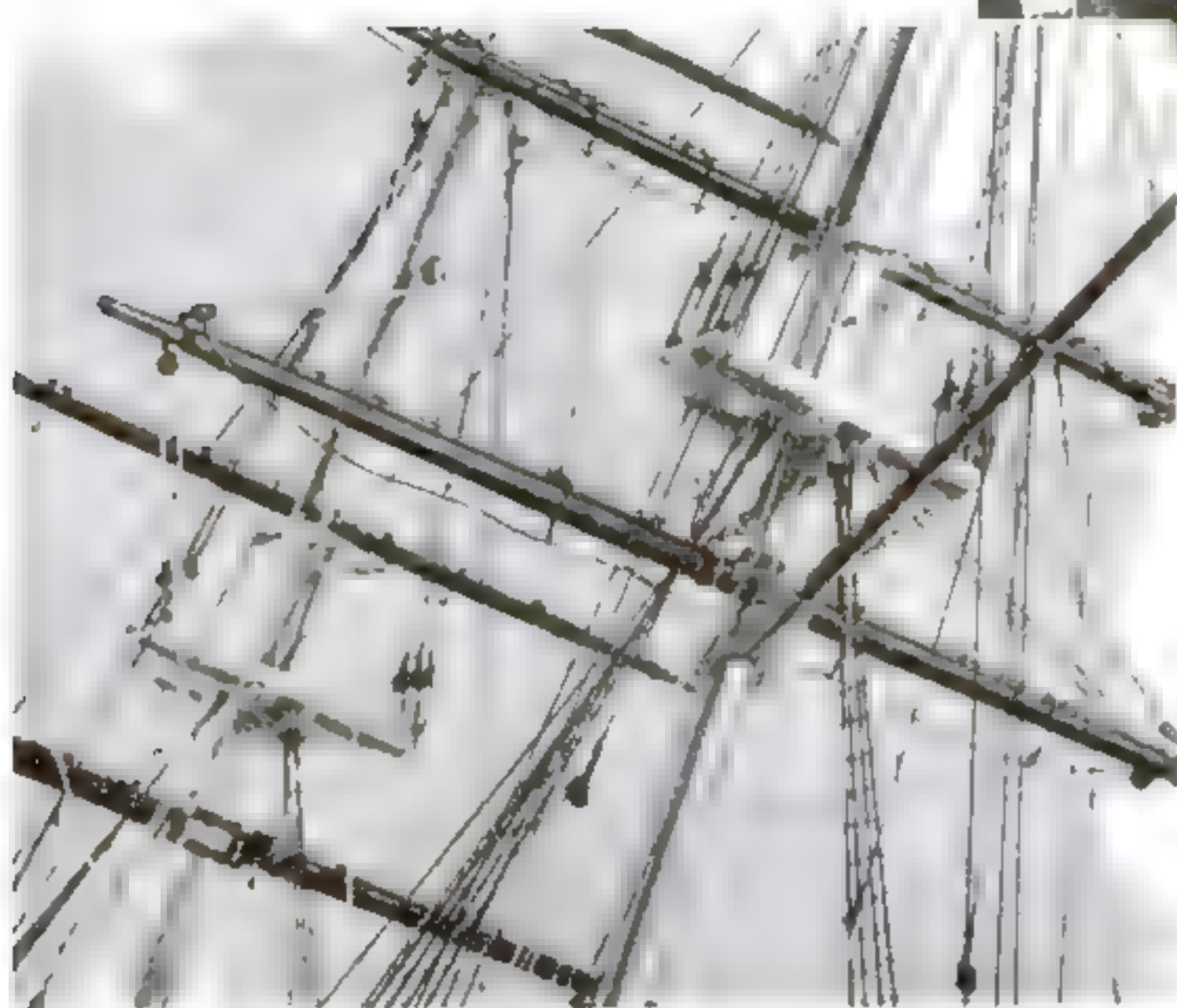
receive the rubber band for each bottle, and a long thumb tack is driven through the band from the underside of the wood. Use wood about 3/4 in. thick for all parts and sand it very thoroughly. Painting or varnishing is not necessary. The idea also can be employed for one baby simply by decreasing the length of the shelf.—JOHN C. MICHALEK.

WE WORK ALOFT on our Brig Model

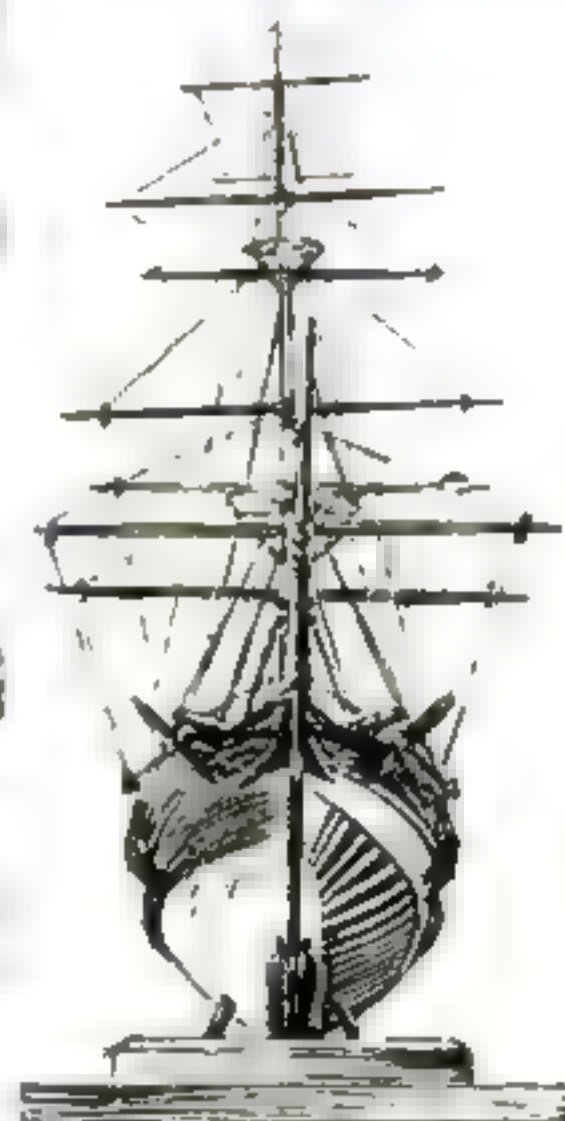
and complete
the rigging



Captain McCann puts the finishing touches on the *Malek Adhel*. She was an American brig and flew the ensign of 1840 with twenty-six stars



A close-up, looking forward, of mainmast, lower yard, and spanker gaff. It also shows the tops and the deadeyes of the topmast shrouds



By
Capt. E. ARMITAGE
McCANN

THE rigging is all that remains to complete our model of the brig *Malek Adhel*, which has been the subject of four previous articles in this series (P.S.M., Mar. to June, '37). Four sizes of black standing rigging and three sizes of light brown or natural color running gear are required (see list, Mar. '37, p. 80).

Shrouds. Stretch the cord well. Pass end around masthead. Seize a deadeye in one end. Pass a lanyard of thin cord to bring the deadeye not quite down to position. Stretch the shroud. Seize in the other deadeye. Pass its lanyard and bring down both together. Then seize the pair of shrouds together under the top.

The lanyards start with a knot at the hole in the deadeye facing the left eye as a sailor would look from inboard out. Reeve them through the other holes and fasten with a hitch around the collar of the shroud.

All shrouds require sheer poles across them to prevent deadeyes from twisting; they are stiff wire, seized on. Ratlines (steps) are fine mercerized sewing cotton or silk, clove-hitched $\frac{1}{4}$ in. apart to lie horizontal. Put ratlines also on futtock

shrouds, from lowermast to mast top.

Forestay is double, goes around mast and under forward crosstrees. Hearts are seized to the ends and are drawn with lanyards to others bolted to the knight-heads.

Mainstay is similar but comes to bolts in deck just abaft the fore hatch. Both are seized together under the tops.

Bowsprit. Ship it to lie on the stem with its heel in the bitts. Pass the gammoning (lashing) tightly to hold it down. Shrouds on either side are chain. Fasten their inner ends to bolts at deck level under catheads; outer ends to deadeyes. Tighten with lanyards to deadeyes fastened to bowsprit. Bobstay also is chain—from a bolt in stem to deadeye under bowsprit. Ship the cap, reeve jib boom through it, and lash. Ship dolphin striker. To its end seize the bight (middle) of a small chain, long enough nearly to reach

the catheads. Use another single piece of chain to reach the boom end. Fasten it there with small wire. Draw the other part (back ropes) tightly to inner bolts on catheads with thimbles and lanyards. Fasten bight of a rope to the boom end; bring it back similarly, direct to middle bolt on catheads.

Topmasts. Place with fids to prevent sliding down. Set crosstrees. Bring shrouds down to deadeyes in the tops. These and remainder of topmast rigging are, of course, a size smaller cord.

Stays. Bring the pairs of topmast backstays down and seize together under the crosstrees. The fore topmast has a double stay leading through bees on bowsprit and tightened with thimbles and lanyards to bolts in knightheads at deck level. (Thimbles may be omitted if desired, and the lanyards or lashings rove through eyes seized in ends of rope.)

Inner jib stay has eye at crosstrees; reeves through hole in jib boom; goes under the upper cleat in dolphin striker, and is tightened with a lanyard to a bolt in the bow.

Main topmast stay starts with an eye at crosstrees; reeves through an eyebolt under fore cap; turns up through eyebolt in top, and is seized there.

Flying jib boom. Lash in position to lie enough to one side of jib boom to clear the jib stay. Rig with thin cord to dolphin striker end, and with another at each side to outer bolts on catheads.

Topgallant masts. Here the stays go on first. Both start with an eye at masthead. The forestay reeves through the flying jib boom, goes under the lower cleat, and is turned up and seized to a bolt in the bow. Seize bights of shrouds together; reeve ends through holes in crosstrees; turn up and seize around short bars seized under the topmast shrouds. Seize bights of backstays together and bring ends down to channels with deadeyes.

Royal rigging is set up similarly, but with thimbles instead of deadeyes.

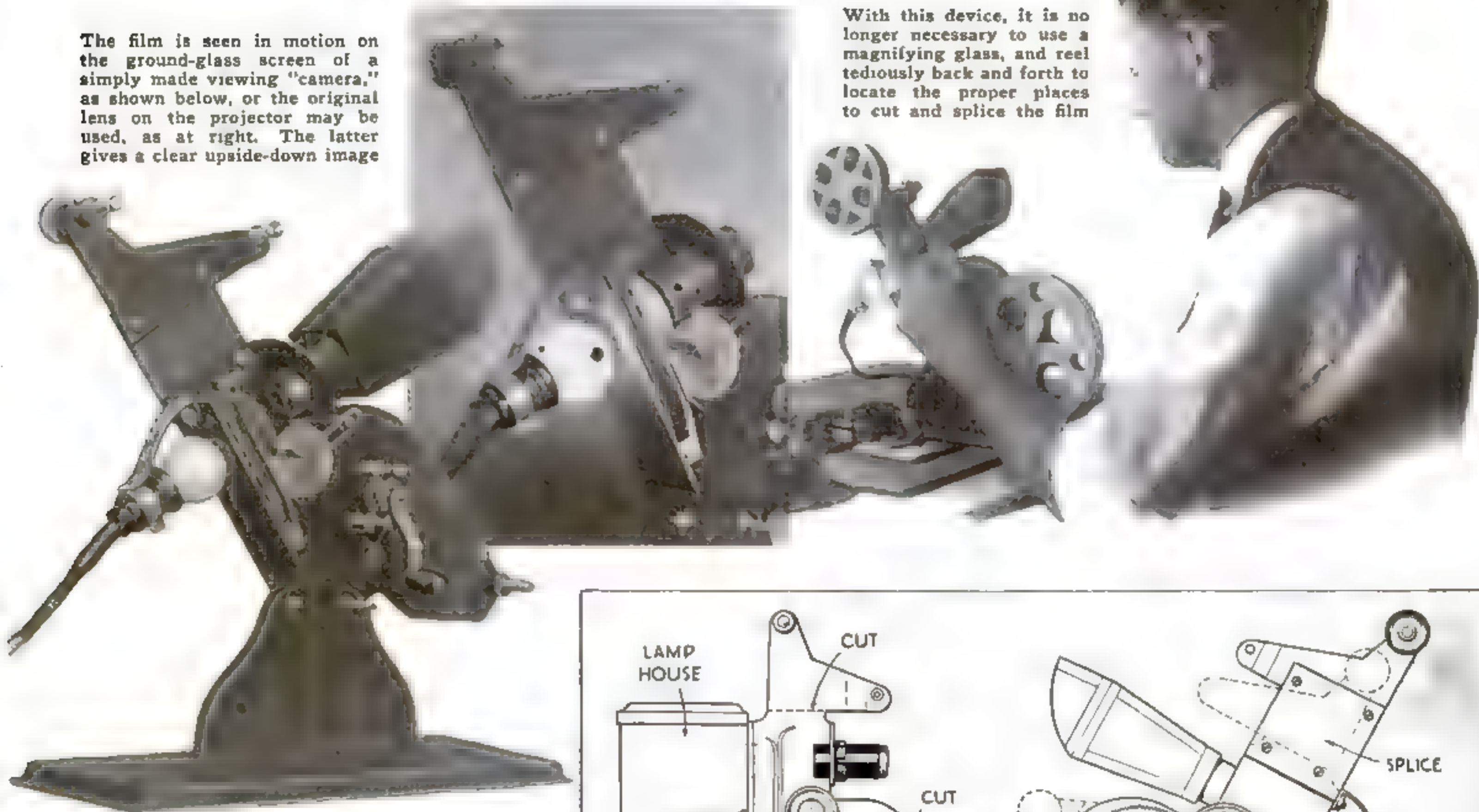
Main topgallant stay is set up to a hole in the fore top- (Continued on page 116)

Improved 'Editor' for Home Movies

MADE FROM A CHEAP TOY PROJECTOR

The film is seen in motion on the ground-glass screen of a simply made viewing "camera," as shown below, or the original lens on the projector may be used, as at right. The latter gives a clear upside-down image

With this device, it is no longer necessary to use a magnifying glass, and reel tediously back and forth to locate the proper places to cut and splice the film



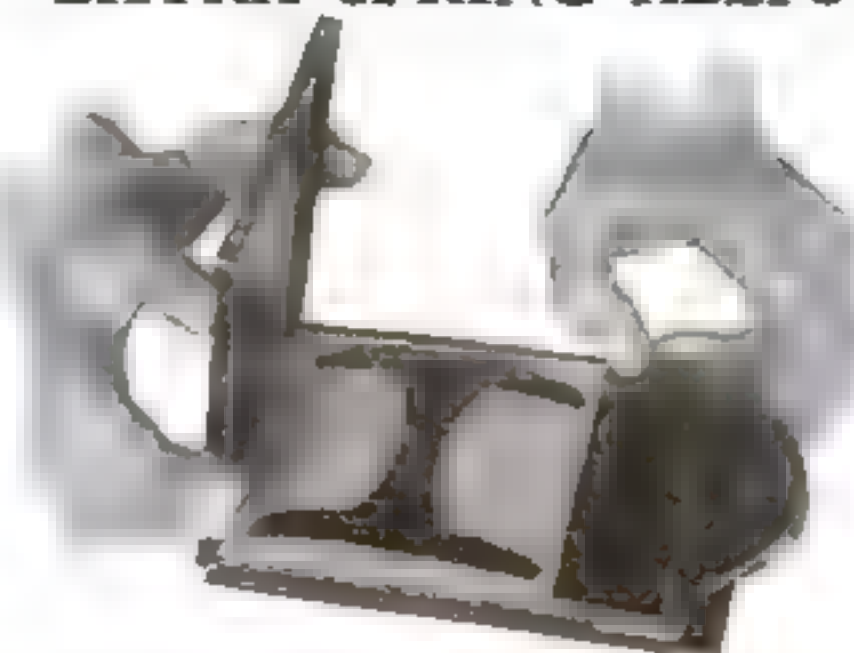
WITH this movie "editor," made from a two-dollar toy projector, a magnified image of the film in motion is seen by the operator on a ground-glass screen. This does away with the difficulties of the one job that tires and annoys so many amateur movie fans—the editing and titling of their films. Of course, excellent commercial equipment is available to minimize this labor, but it is somewhat expensive.

To adapt the toy projector to carry standard 400-ft. reels, the two ends were cut off as indicated and pieces of 1/16-in. thick sheet iron were spliced in. The position of the lower reel was altered at the same time so as to straighten out the whole assembly and make room for the viewing "camera."

The lamp house was discarded, and a piece of the angle or flange fastened to it was cut out to enable the lower corner to be bolted to the base at an angle. This allows the reels to turn freely. A socket from an outdoor type of Christmas-tree light string and a 10-watt frosted bulb were used for illumination.

The viewing device consists of a lens from a linen tester of the kind to be found in any optical shop and a ground-glass screen, mounted as shown. An even simpler method would be to use the original lens on the projector, in which a smaller image is seen, clear but upside down. With the ground-glass screen, the image may be any reasonable size depending on the focal length of the lens and the length of the "camera." The one illustrated has a frame 2 in. wide.—B. G. SEIELSTAD.

EXTRA SPRING HELPS KEEP FILM PACK IN FOCUS



BECAUSE a film pack is thinner than the adapter in most cases, the film being exposed is not always kept in true focus. This is easily remedied by placing a spring back of the film pack inside the adapter. A spring for this purpose can be obtained by dismantling a used film pack and taking the spider used to keep the films pressed forward in the pack. It should be cut from the frame at each side and used as at the left.—EMIL PEARSON.

Inexpensive, Simple to use—and how they step up your Picture-Taking Skill

KODAK PORTRAIT ATTACHMENT



The ordinary hand camera is not designed to take pictures at extremely short distances. But a Kodak Portrait Attachment slipped over the lens of Kodak or Brownie keeps the image sharp.

Then you're all set to make "close-ups" of your family and friends, as well as clear-cut, close-range pictures of flowers, art objects, and still-life

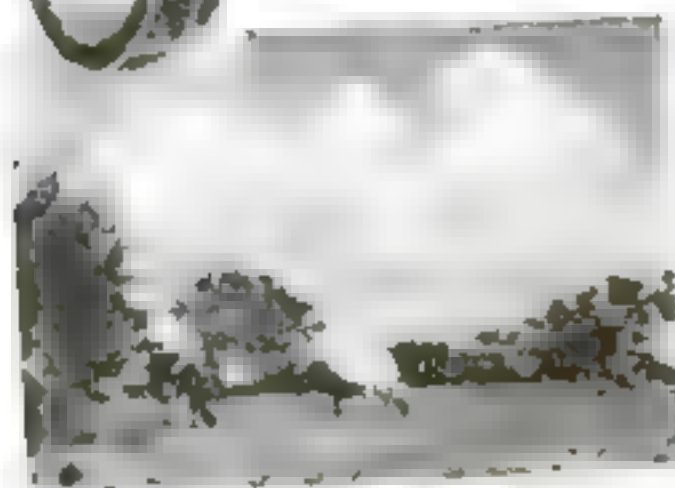


subjects in general.

And it's all so very easy, too. The attachment is quickly slipped over the regular lens and the camera is operated as usual. Price, for most current camera models, 75¢.



KODAK SKY FILTER



Slipped over your regular lens, it holds back the light from the blue sky and gives you beautiful cloud effects. The darker portion of your picture, the landscape, gets full exposure. Price, depending on camera model, \$1, \$1.50, \$3.30.



KODAK COLOR FILTER



Holds back blue and violet rays reflected from highly colored flowers and landscapes, gives weaker shades time to register. With it black-and-white pictures render all colors more nearly as the eye sees them; they're much more natural. Price, depending on camera, \$1, \$1.50, \$3.30.

KODAK ADJUSTABLE LENS HOOD



Prevents "lens flare" in bright light, and in making artistic backlighted shots. Two sizes, 85¢ and \$1, depending on the diameter of lens or lens attachment over which the hood is to be used.



KODAK METAL TRIPODS

Light, compact, rigid; they fit any standard tripod socket. The sections telescope neatly to give small collapsed size without sac-

rifice of strength. Three models, ranging from 13½ to 15½ inches long, closed. Nos. 1 and 2 have revolving heads; the camera may be swung in any direction desired. Prices, No. 0, \$2.75; No. 1, \$4.50; No. 2, \$5. Rubber tips, to cover metal spurs for indoor use, 10¢ for set of three.



KODAK SELF TIMER

Lets you get in the picture yourself. You clip it to cable release, set it, and, in a sufficient time interval, shutter is automatically tripped. Price, \$1.25. Cable release (in purchasing, specify name of camera) 35¢ additional.



THE KODAPOD

Toothed jaws grip tree or fence, other end threads into any standard tripod socket. Clamping screw adjusts camera to correct position. Carried in coat pocket. Price, \$1.75.

KODAK POCKET RANGE FINDER

Used with any camera that has a focusing scale. Look through the eyepiece, turn the knurled ring until the two halves of the image are perfectly matched, and there's your correct distance, indicated by a pointer. Set for that distance, and subject is in focus. Spring pocket-clip. Price, \$7.



SEE THEM AT YOUR DEALER'S

Eastman Kodak Company, Rochester, N. Y.

AUTO IDEAS

Time-Saving Suggestions
For Car Owners Made By
Our Experienced Readers

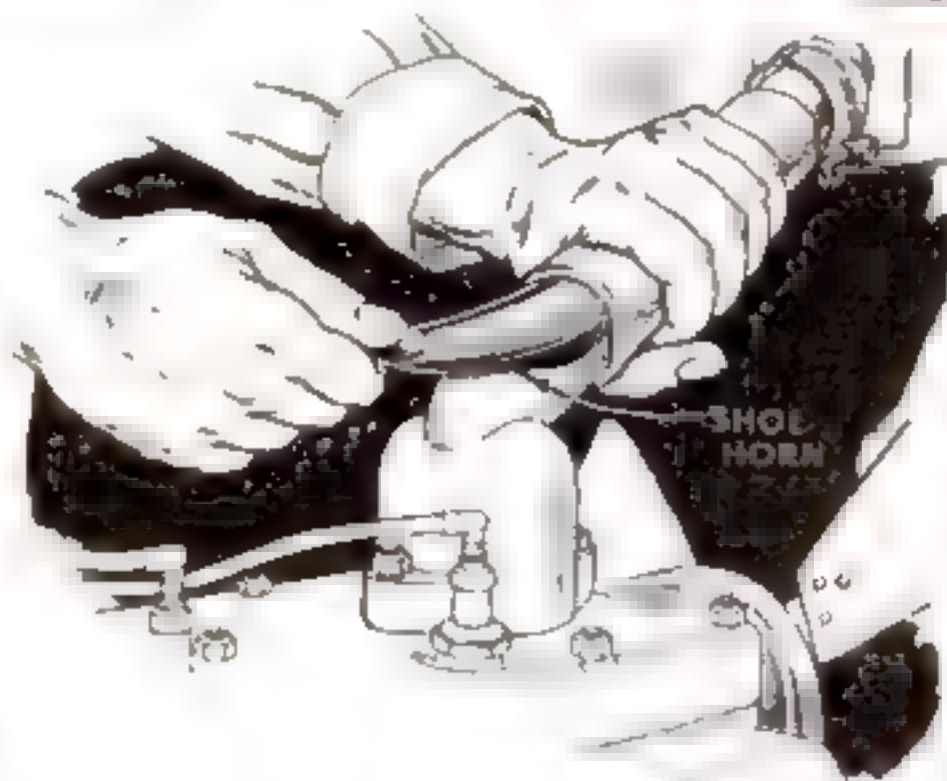
Funnel Provides Illumination

WHEN my car went dead several nights ago, I discovered that I had left my flash light at home. As I floundered in the dark, my son, deciding to clean a funnel which we had borrowed together with a can of gasoline from a garage, accidentally held it up in front of the headlights. To my surprise, the shiny conical surface reflected a strong beam of light back on the motor. Experimenting, I found that a good deal of illumination could be reflected back in this way for all sorts of repair jobs.—E. C. H.

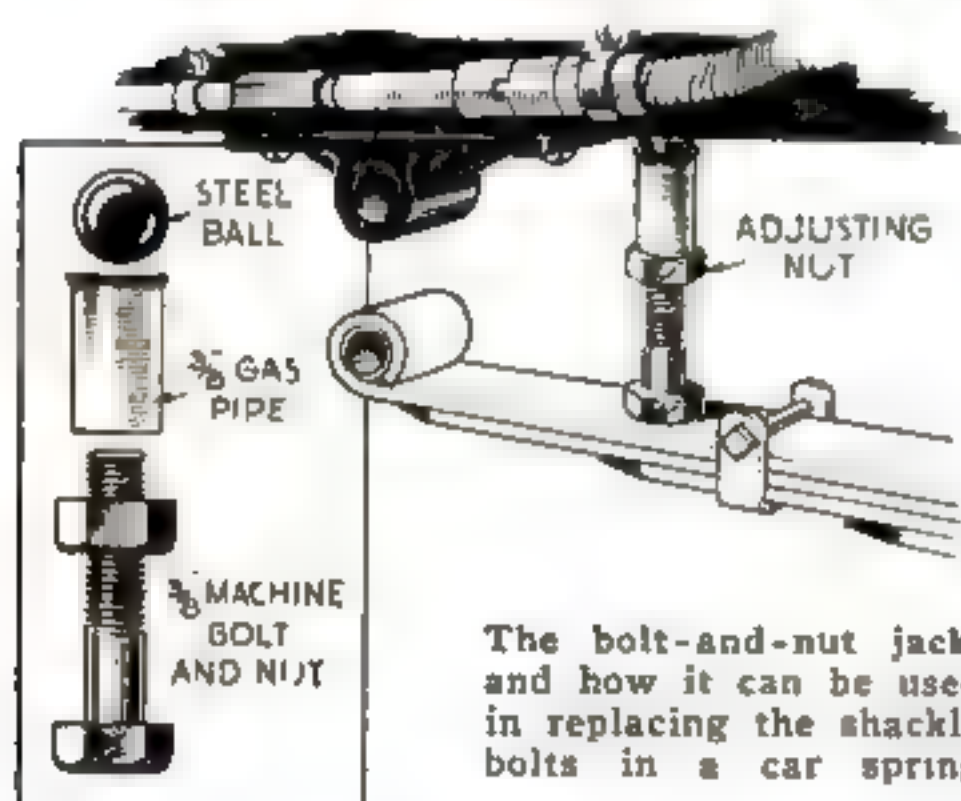


Shoe Horn Aids In Replacing Hose

THE PROBLEM of forcing the loose end of a new section of radiator hose over the pipe leading to the motor head can be simplified by making use of an ordinary metal shoe horn in the manner illustrated at the right. Push one side of the hose over the pipe end and then use the horn as a lever to ease the opposite edge into place. While the shoe horn is manipulated with the right hand, the left can force the hose over the end of the pipe with a twisting motion. The parts will go together more easily if both the hose and pipe are lubricated with water.—A. W.



Handy Midget Jack Made From Bolt and Nut



FROM an ordinary machine bolt and nut, a scrap of gas pipe, and a steel ball bearing, the amateur mechanic can provide himself with a powerful midget jack that will prove valuable for many types of repair jobs. As shown in the drawing, the jack is assembled by slipping the pipe over the end of the bolt and placing the ball bearing in the upper end of the pipe. To adjust the jack, it is necessary only to turn the nut with a wrench. A considerable amount of lifting power is obtained.—F. C.

Cotton Finds Tacks In Tires

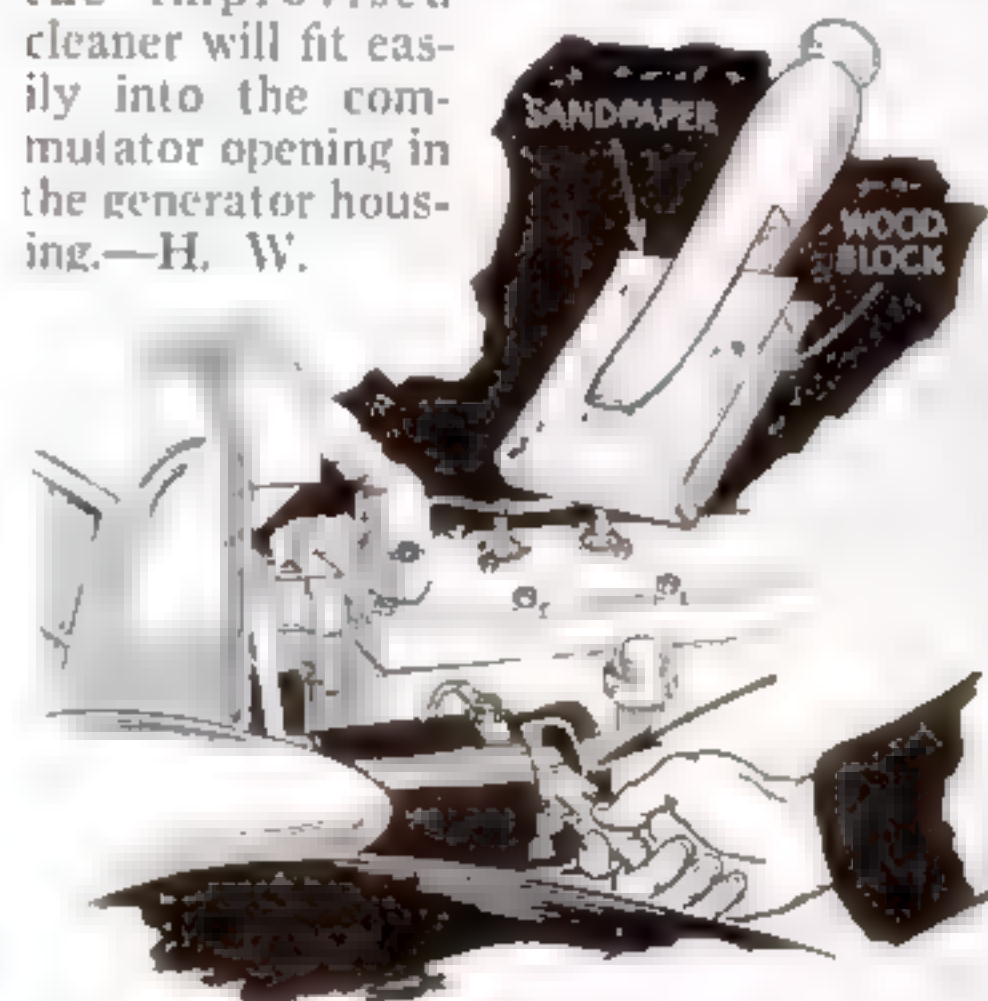


THE NEXT time you have difficulty locating the tack or nail that caused a punctured tire, rub a large wad of absorbent cotton around on the inner wall of the shoe. No matter how small the point of the nail or piece of metal may be, it will catch in the cotton and pull off a telltale tuft that will indicate its exact position in the inner wall of the shoe.—W. H.



Clothespin Forms Holder for Sandpaper Strips

A HANDY commutator cleaner for generator work can be made from an ordinary wooden clothespin. Simply fold a strip of sandpaper over a thin block of wood cut to the width of the commutator, and force both the block and the paper between the jaws of the pin, as shown below. Because of its long, narrow handle, the improvised cleaner will fit easily into the commutator opening in the generator housing.—H. W.

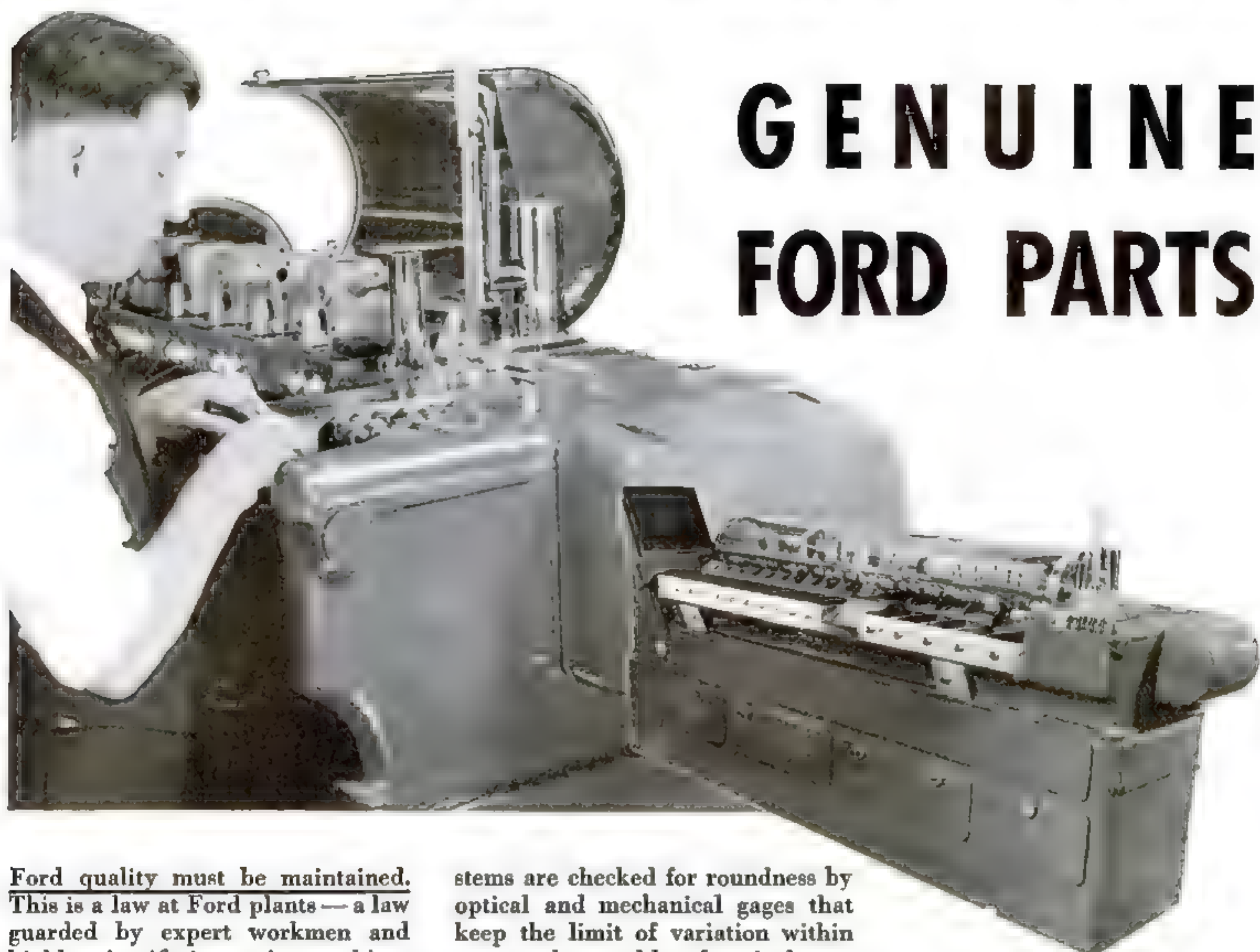


Priming a Stalled Motor Through the Carburetor

WHEN a modern car runs out of gas and the tank has been refilled, it generally takes some time to get the motor started again. This is caused by the fact that the engine must be turned over long enough to allow the fuel pump to draw the gasoline up from the tank. The battery can be saved and the engine started immediately, however, if the cylinders are primed by removing the air cleaner on the down-draft carburetor and pouring a small amount of gasoline directly into the intake opening.—L. V. H.

Inspections, which no human skill can equal, guard the quality of

GENUINE FORD PARTS



Ford quality must be maintained. This is a law at Ford plants — a law guarded by expert workmen and highly scientific inspection machines during every phase of the manufacturing of Genuine Ford Parts.

One machine, for example, checks piston pins for smoothness, hardness, straightness, roundness and diameter at the rate of 1500 per hour. At one stage of the inspection an automatic scleroscope checks the pin for hardness. A small hammer is allowed to fall upon the pin. The rebound of the hammer measures, to a fine degree, the hardness of the metal. If the metal is of the correct hardness, the hammer rebounds to intercept a light beam from a photo-electric cell which automatically allows the pin to proceed for further inspections.

Another inspection machine gages camshafts at 25 points at the rate of 500 camshafts per hour. And valve

stems are checked for roundness by optical and mechanical gages that keep the limit of variation within two ten-thousandths of an inch.

Because of such accurate and scientific inspections, because of Ford quality materials and Ford precision manufacturing, you can be sure of getting the best parts for your Ford by buying them from your Ford dealer or any garage that displays the sign "Genuine Ford Parts."

This automatic valve lifter inspection machine performs eleven different inspections on 35 valve lifters per minute — a total of 385 inspections.



Genuine Ford
Cut-outs have large coin-silver contact points. Layers of the shunt-coil windings are insulated individually. Series coil winding has full generator output carrying capacity.



All Genuine Ford Piston Pins are inspected for smoothness, hardness, straightness, roundness and diameter. Diameters are held within a variation of one ten-thousandth of an inch of specified sizes.

Clutch Disc Assembly. All discs are carefully inspected to make certain that all parts measure up to specified requirements.



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WE'RE THROUGH USING MISFIT BLADES

—say men everywhere

*Unsolicited letters tell
why it pays to use only
Gillette Blades in the
Gillette Razor*



RIGHT BLADE FOR THE GILLETTE RAZOR

After using several other make blades I went back to Gillette and got such wonderful shaves that I am going to keep right on using them. It makes a big difference when you use the right blade for your Gillette Razor.

*R. D. Bellinger,
166 East 96th St., N. Y. C.*

FACE SORE FROM MISFIT BLADES

At times I tried other brands of blades, but they do not shave anywhere as well as the Gillette Blade in my Gillette Razor. I have found my face raw and sore from these misfit blades — but Gillette Blades shave always comfortable.

*George F. Lyman
61 Moseley St., Dorchester, Mass.*



★ The Gillette Blade is made to FIT the Gillette Razor. No worry about too much shaving edge to scuff your skin; nor too little shaving edge to leave patches of stubble behind. Slip a Gillette Blade into your Gillette Razor tomorrow and enjoy shaving comfort at its best.



Gillette Blades
Precision-made for the Gillette Razor

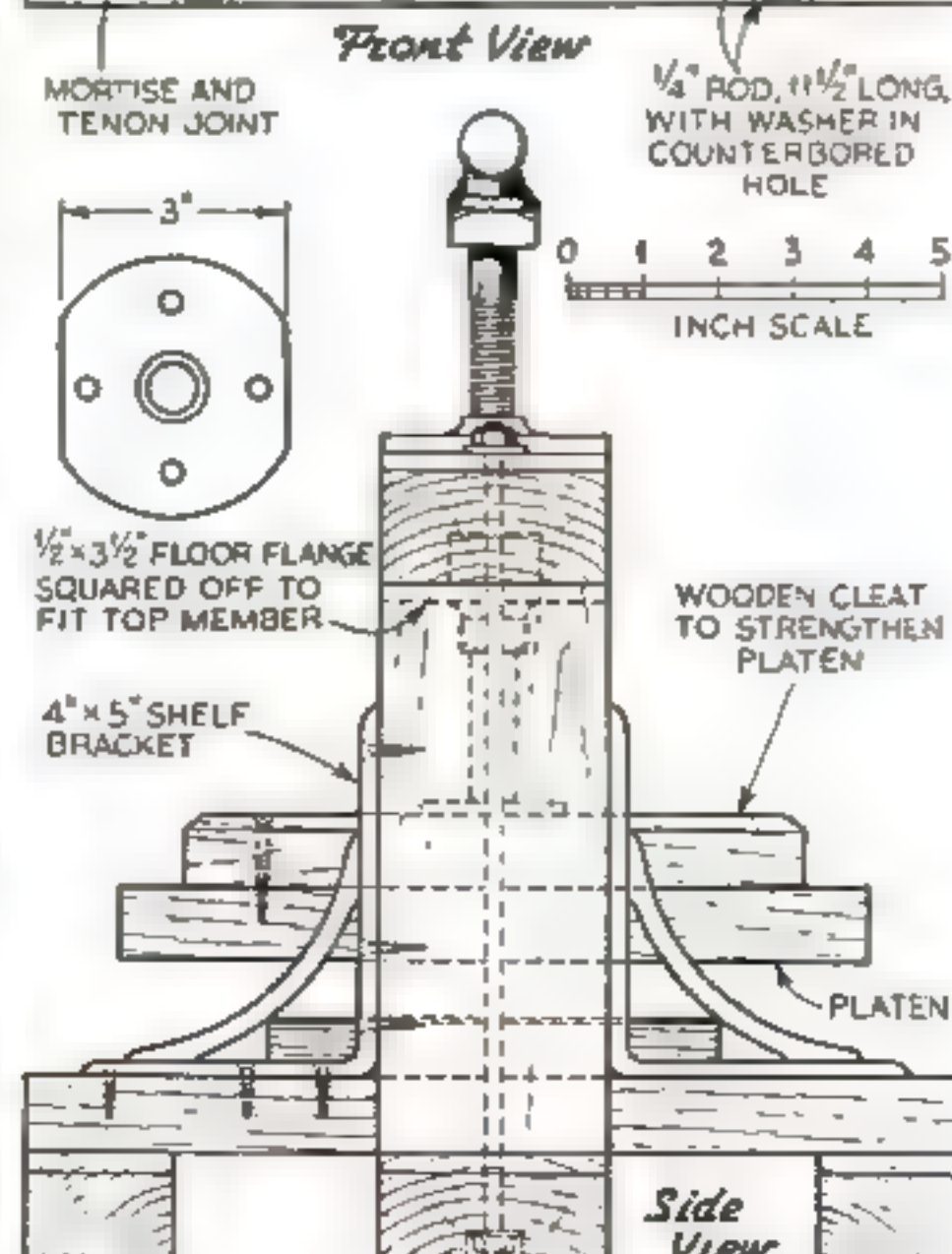
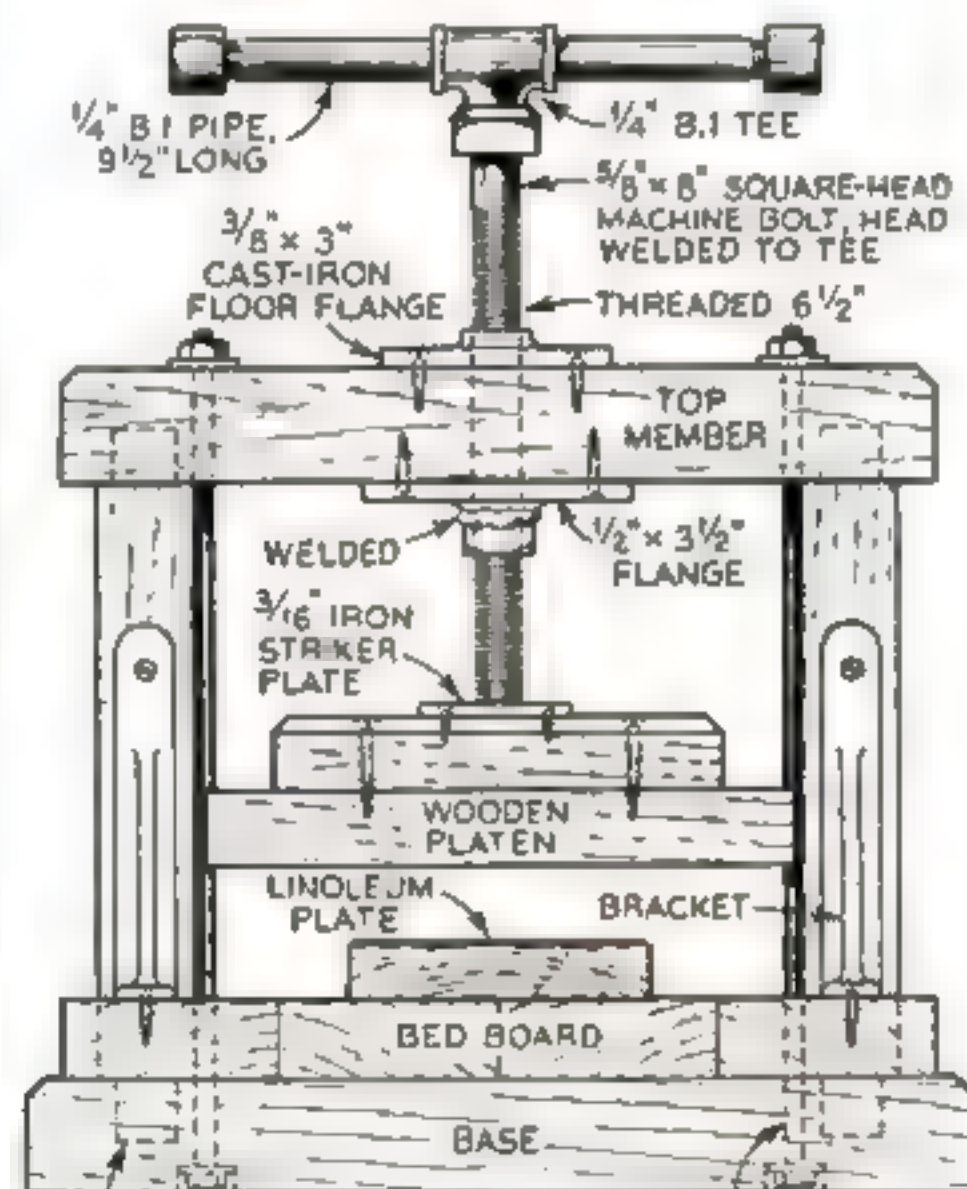
Utility Press

FOR
BLOCK
PRINTING

THE design of this practical screw press is the result of considerable experience and much experimentation in the use of various types of presses for linoleum-block printing, bookbinding, veneering small panels, making in-laid pictures, and other gluing and pressing operations. The bed will take work measuring 7 by 10 in. or smaller.

Either oak or maple is used for the wooden parts, and the total cost should not exceed

Making a print from a linoleum block. The bottom of the platen is padded with cloth thumb-tacked to the ends



three dollars. The entire assembly is screwed and bolted together. Glue is used for the mortise and tenon joints, and four shelf brackets stabilize the side supports.

The working drawings show the size and position of all members, and the list of materials has been determined from actual working conditions. Only two suggestions are necessary to assist the novice. First, the two outside bed boards are to be scribed and cut to fit tightly around the side supports; second, the platen is to be grooved at the center of either side deep enough to form a guide working against the 1/4-in. rods.

It is an excellent plan to oil, varnish, or shellac the wooden parts.—W. W. WHEATLY.

List of Materials

- 2 pc. 1 1/2 by 2 by 12 1/2 in., for outside bottom supports.
- 1 pc. 1 1/2 by 3 by 12 1/2 in., for middle bottom support.
- 4 pcs. 1 by 2 3/8 by 12 1/2 in., for bed.
- 2 pcs. 1 1/4 by 3 by 9 1/2 in., for side supports.
- 1 pc. 1 1/2 by 3 by 11 1/2 in., for top member.
- 1 pc. 1 by 7 3/4 by 10 in., for platen.
- 1 pc. 1 by 6 by 8 1/4 in., for platen cleat.
- Note: This material is either oak or maple.
- 2—11 1/2 by 1/4-in. hex-head rods, with washers and nuts.
- 4—4 by 5-in. wrought steel japanned shelf brackets with 24 flathead black wood screws, 3/4-in. No. 6.
- 1—8 by 5/8-in. squarehead machine bolt, threaded 6 1/2 in., with nut.
- 1—1/2 by 3 1/4-in. cast-iron floor flange, to be welded to 5/8-in. machine-bolt nut.
- 1—3/8 by 3-in. cast-iron floor flange, reamed to form collar for bolt.
- 1—1/4-in. black iron tee reamed to receive 1/4-in. pipe handle and welded to head of 5/8-in. machine bolt.
- 1—1/4 by 9 1/2-in. black iron pipe, threaded both ends for handle.
- 2—1/4-in. black iron pipe caps, for handle ends.
- 1—2 by 3/16-in. flat iron for striker plate, drilled and countersunk for four No. 6 flathead wood screws.
- 24—1 3/4-in. No. 6 flathead bright wood screws, to fasten bed to bottom support: 6—5/8-in. No. 6 screws, for striker plate and 3/8-in. floor flange; 4—3/4-in. No. 6 screws, for 1/2-in. floor flange; and 4—1 1/2-in. No. 6 screws, to fasten platen cleat to platen.



Old
Bill

SAYS:

YOU can increase the life and efficiency of a spiral milling cutter by cutting nicks in the teeth with a $\frac{1}{8}$ -in. cut-off wheel. Space them $1\frac{1}{2}$ in. apart, starting $\frac{3}{4}$ in. from the end of one tooth and $1\frac{1}{2}$ in. from the end of the next.

Whitewood is satisfactory for making economical laps. Turn, bore for an expansion plug, tapering about $\frac{1}{8}$ in. to the foot, and slit the lap one half of its length.

If a wheel appears to cut from the corners when grinding a long shaft, the trouble is very likely misalignment between the traverse carriage and wheel slide. For best results, centralize the carriage with the wheel and dress from that location, never from the tailstock.

With carbon tool steel it's the carbon range that counts. Since it may vary within wide limits, select the correct analysis for the intended tools. Don't be backward in making inquiries of the manufacturer if necessary. One certainly can't make a blanking die and a cold chisel from the same analysis.

The correct drive for die-shoe posts is .0015. Don't trust the drawing, but check the actual size of the bores separately.

A mechanic who attempts free-hand sharpening of automatic-head chasers belongs to the pick-and-shovel gang. The least one can do is to make an improvised fixture to maintain uniformity throughout.

By milling evenly spaced slots in a piece of cold-rolled steel and welding in high-speed steel blades, one can make a variety of economical boring or reaming tools.

The latest method of holding nonferrous materials on a magnetic chuck is to use small vacuum rubber cups along with coil springs to create a pull. A U-shaped fixture for this purpose can be made for a few dollars.

A silicon-carbide point and a lubricant of one part lard oil and two parts kerosene are excellent for drilling glass.

Many large bores can be made by the trepanning method with a great saving in material. Always consider material as cash.

The only way to test a milling-machine arbor for concentricity is to indicate the extreme end near the thread. Arbors worn undersize, but otherwise in good condition, can now be economically salvaged by being chromium plated, provided a perfect straightening job is also done.

The lubricant has much to do with cutting a good thread. Use paraffin oil for brass, bronze, and copper tubing and bar stock; mineral oil for chromium alloys and tool steel; lard oil and white lead for steel forgings, and kerosene for aluminum and its alloys.



OL' JUDGE ROBBINS

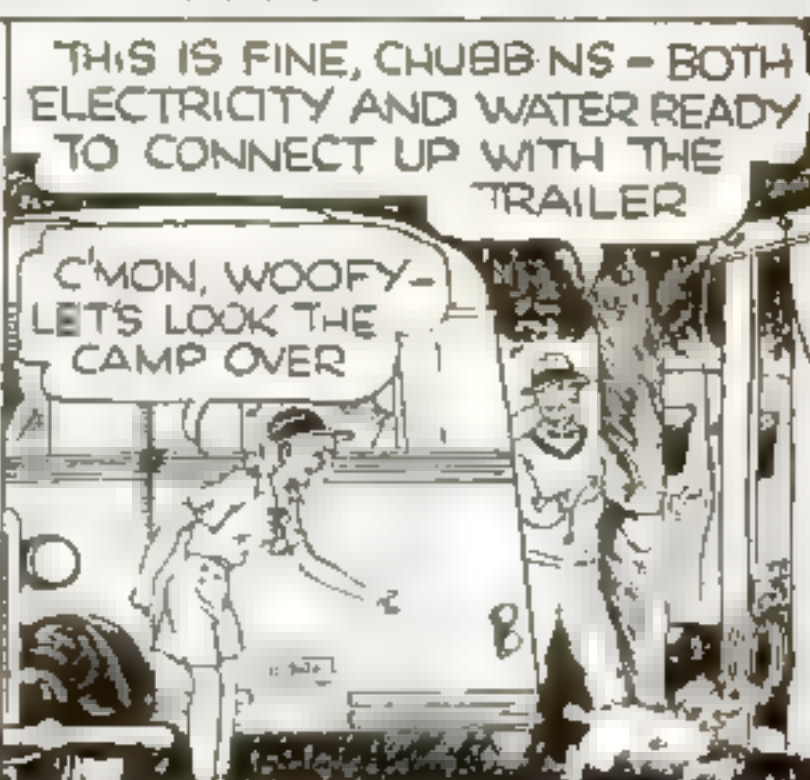
THE JUDGE, CHUBBINS, AND HER NEW DOG, WOOFY, STOP AT A TRAILER CAMP



GOODNESS ME, WOOFY—THIS IS A BIG TRAILER CAMP—OH—THERE'S SOME MORE LITTLE DOGGIES

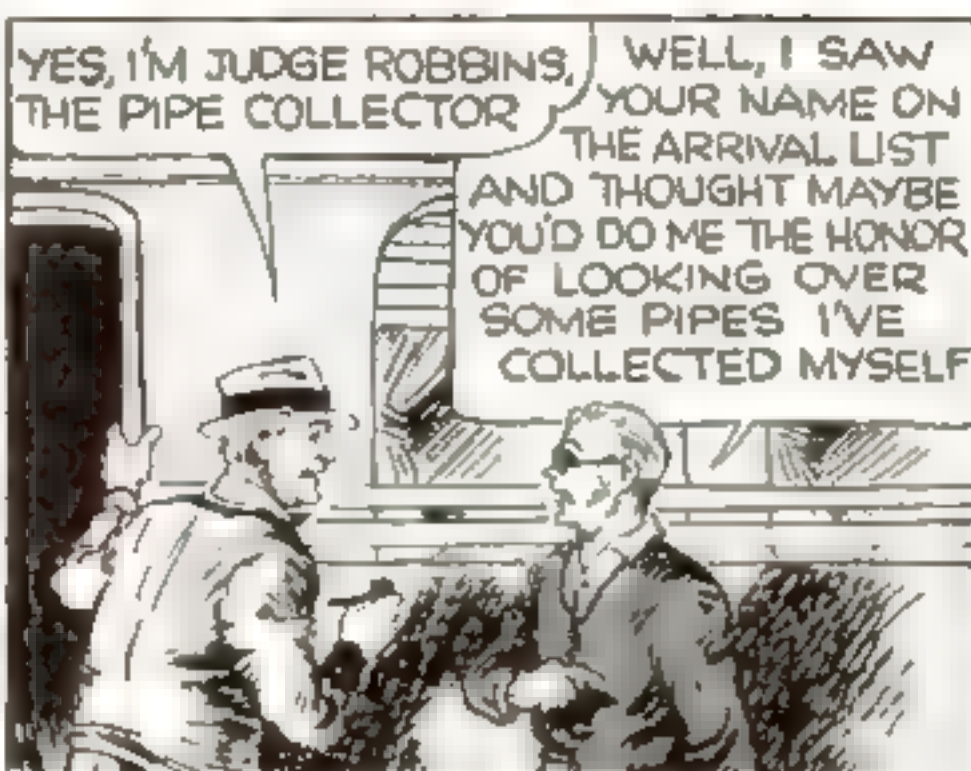
DRIVE OVER THERE, SIR—UNDER THAT TREE

WOOF!



THIS IS FINE, CHUBBINS—BOTH ELECTRICITY AND WATER READY TO CONNECT UP WITH THE TRAILER

C'MON, WOOFY—LET'S LOOK THE CAMP OVER



YES, I'M JUDGE ROBBINS, THE PIPE COLLECTOR

WELL, I SAW YOUR NAME ON THE ARRIVAL LIST AND THOUGHT MAYBE YOU'D DO ME THE HONOR OF LOOKING OVER SOME PIPES I'VE COLLECTED MYSELF



H-M-M A SPLENDID EXAMPLE OF A LEAD INDIAN PIPE—A GREAT FAVORITE OF THE TIMES—IT'S AN EXCELLENT MODEL AND LOOKS OVER ONE HUNDRED YEARS OLD



I'M AFRAID MY FEW PIPES HAVEN'T MUCH IN COMMON WITH YOUR MARVELOUS COLLECTION

THERE'S ONE THING ALL PIPES HAVE IN COMMON—THEY ALL SMOKE Milder AND TASTE BETTER WITH PRINCE ALBERT



JUDGE, YOU CAN SEE FROM THE LICENSE PLATES THERE ARE FOLKS HERE FROM EVERY STATE—AND ALMOST EVERY SMOKER AMONG THEM IS CARRYING P.A.

WELL, YOU KNOW P.A. IS THE LARGEST-SELLING SMOKING TOBACCO—THE 'CRIMP CUT' AND 'NO-BITE' PROCESS MAKE IT THE NATIONAL JOY SMOKE FOR MILDNESS AND GOOD TASTE

Copyright, 1937, R. J. Reynolds Tobacco Company



IF YOU'VE LAID YOUR PIPE ASIDE BECAUSE OF 'TONGUE-BITE' TRY P.A. IT'S AMAZINGLY MILD!



**THIS WAY TO
HAPPIER PIPE-SMOKING!
—READ SPECIAL TRIAL OFFER**

Smoke 20 fragrant pipefuls of Prince Albert. If you don't find it the mellowest, tastiest pipe tobacco you ever smoked, return the pocket tin with the rest of the tobacco in it to us at any time within a month from this date, and we will refund full purchase price, plus postage.

(Signed) R. J. Reynolds Tobacco Company, Winston-Salem, N.C.

50 pipefuls of fragrant tobacco in every 2-oz. tin of Prince Albert





Teeth that BITE!



Metal cutting teeth that out-cut and out-last any other blade. Each ATKINS tooth BITES cleanly and keenly into metal because it is made from the famous formula for "Silver Steel" that revolutionized metal cutting. Atkins teeth are engineered correctly — machined with precision — alloyed to give proper tensile strength and cushion the shock and strain of metal cutting.



A fine tool for your shop

ATKINS No. 10, "Pistol Grip" Hack Saw Frame is designed to get the utmost out of metal cutting. Fits the hand comfortably. Easy to change blades. Exactly made and balanced as the finest tool should be. Your dealer should have the finest metal cutting blades—ATKINS "Silver Steel."

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An Interlocking Tower

To Improve Your MODEL RAILWAY



By
HAROLD A. SCHUPP

YOU can add a lot to the appearance of the yards of your model railway layout if you construct a realistic looking interlocking tower near the main terminal. The design shown was taken from an actual tower. The more important dimensions are given in feet, and all other needed measurements may be found by using the foot scale and a pair of dividers. This enables the model railroader to build to whatever scale he happens to be using throughout the system.

The original tower is of brick with a concrete foundation and a red tile roof. To save work, get some brick paper in the correct scale and use that to cover the walls.

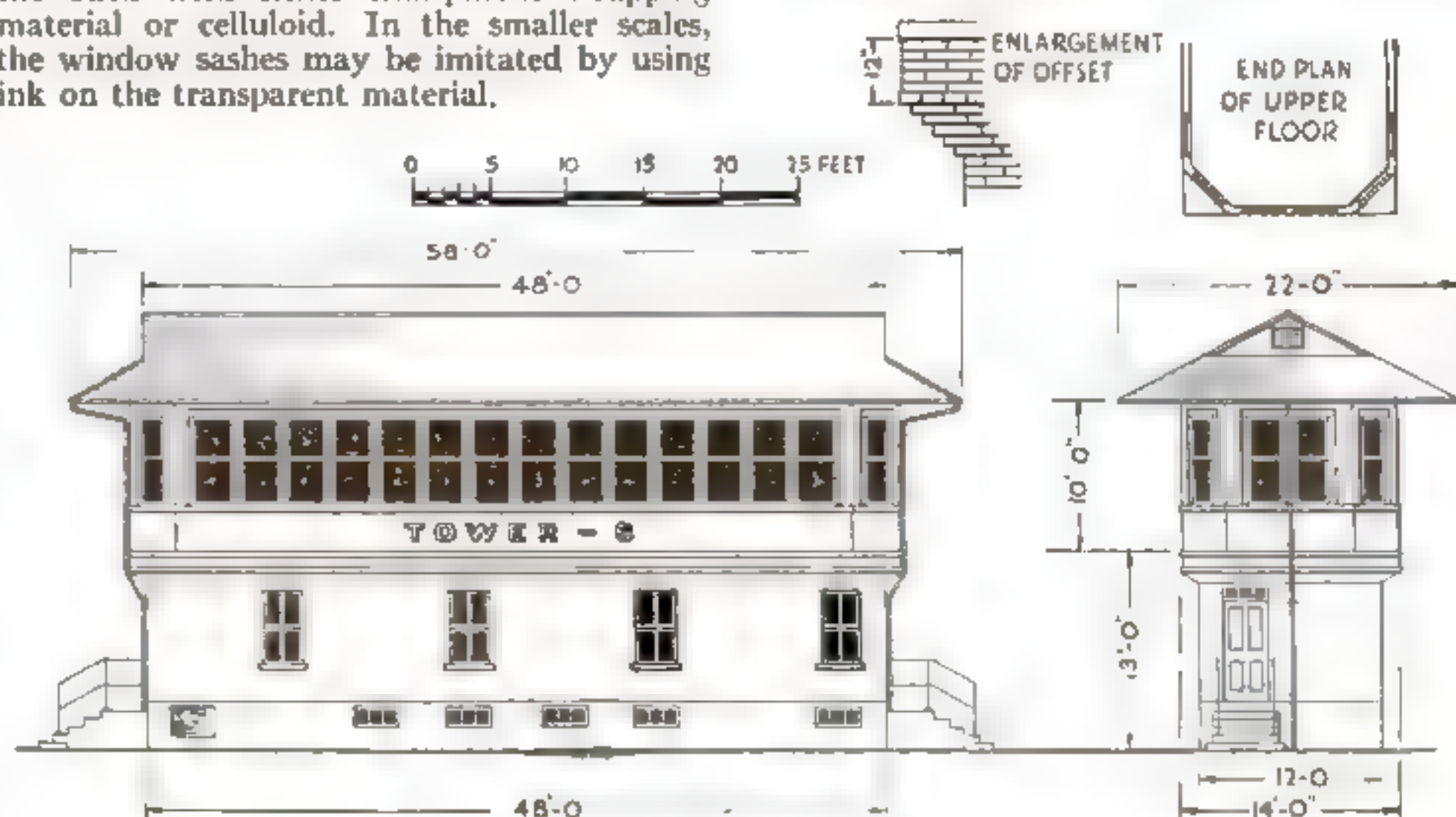
The tower is best built by using Bristol board or something similar for the walls and roof, and reinforcing this with a floor of wood and wooden bracing wherever necessary. All of the walls are cut out separately.

After the window and door openings are cut out, the sashes and doors are made of separate pieces of thin card glued behind the openings. The windows are then covered on the back with either transparent wrapping material or celluloid. In the smaller scales, the window sashes may be imitated by using ink on the transparent material.

The tower is erected by gluing the walls for the lower story around a softwood block. To make the offset between the control floor and the lower floor, glue fairly heavy strips of wood around the tops of the lower walls, and glue on top of the walls additional layers of wood of the required thickness, each one larger than the one just below it.

The roof is carefully cut to shape, scribed to represent tile, and then glued together with strips of wood underneath for strength.

The window sills are narrow strips of thin card, glued on and painted to represent concrete. The top half of each of the windows in the upper story may be painted a dark green to represent window shades. The window frames, doors, and the small gable on each end of the roof are painted white. The roof is a tile red, while the foundation and steps are painted to represent concrete. Railings are black. The gutter should be painted black on the topside, but the rest of it, and the down spouts also, should be a box-car red. The building may be lighted, if desired.

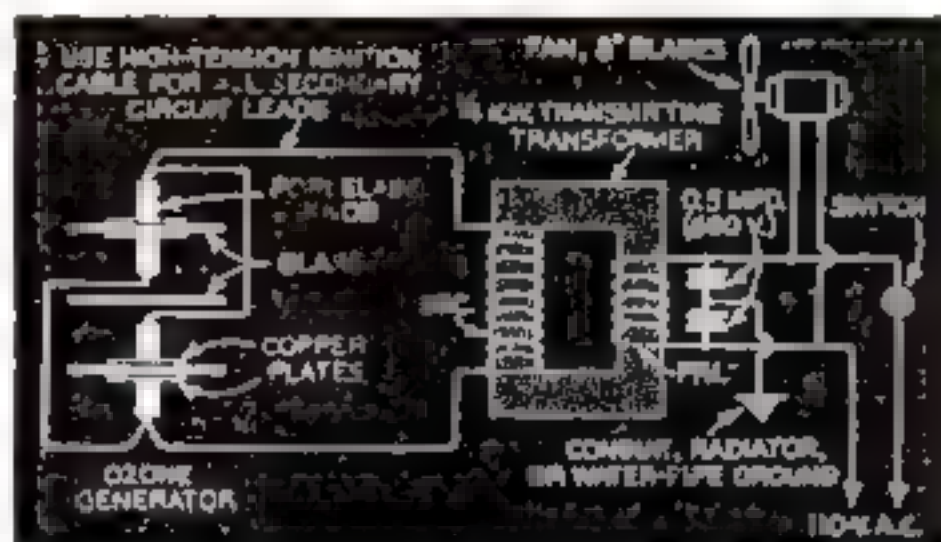


Dimensions and scale are given in feet so you can build your model to whatever scale you wish

AN OZONE GENERATOR

(Continued from page 78)

Wiring. The primary leads to the service outlet consist of about 20 ft. of No. 14 flexible lamp cord. To protect against any high-voltage surges, two 0.5-mfd. condensers are connected as in the wiring diagram. The junction between the two condensers is connected and soldered to both conductors of a piece of No. 14 lamp cord as long as required, and a radio ground clamp is used to connect both con-



How the apparatus is wired if a ¼-kilowatt radio transmitting transformer is utilized

ductors with a radiator or water pipe. This is not required with a neon sign transformer.

Operation. Attach the ground clamp before turning on the switch. The ozonized air will be diffused throughout the room by the fan and detected by its peculiar sweet odor. The device need not be in constant operation; it is merely turned on as required to keep the air fresh. The required proportion of ozone to air for sterilization purposes is very low; in fact it has been found that impure water containing as much as 1,000,000 bacteria per cubic centimeter will be completely sterilized when placed in contact with one cubic centimeter of air containing two grams of ozone per cubic meter, or 0.07 oz. of ozone in 1.2 cubic yards of air.

Precautions. Avoid jarring the apparatus, which might crack the glass plates. Caution small children against poking any object through the screen, as the high-voltage current will follow materials that may be almost perfect insulators for low voltages. Do not move the device while in operation, and do not stand directly in front of the screen and breathe the full strength of the ozonized air.

LIST OF MATERIALS

- 1 transformer as specified in text.
- 2—0.5-mfd. condensers, 600 volts.
- 3 pc. 5 by 7-in. glass from photographic plates.
- 4 porcelain knobs, 2 in. long.
- 4 copper plates, 3 by 4 in., 28-gauge.
- 4 pieces insulating panel composition (phenol-formaldehyde), ½ by 2½ by 6½ in.
- 1 threaded brass rod, ¼-in. diameter, 12 in. long, 16 brass washers, and 12 hexagon brass nuts.
- 1 pc. bronze screen, 8 by 11½ in.
- 1 fan, 110 volts, 60-cycle, 8-in. blades.
- 1 radio ground clamp.
- 5 ft. rubber-insulated, high-tension ignition cable.
- 50 ft. No. 14 flexible lamp cord.
- 1 toggle snap switch, 3-ampere, 110 volts.
- 6 ft. No. 14 N.E.C. rubber-covered wire.
- 6 pairs of porcelain wire cleats.
- 1 sheet-metal clamp for motor mounting: rubber, cellulose tape, screws, etc.
- Wood, plywood, finishes, etc., for constructing cabinet of any design desired.

PAPER CLIPS LINKED TOGETHER FOR HANGING PICTURES

WHEN a small picture is to be hung and no picture wire is available, a chain made of the common type of long, narrow wire paper clips will serve the purpose.—I. M. HOWARD.

CHAMPIONS IN VACATION LAND



TROUBLE-FREE MOTORING DEPENDS ON SPARK PLUGS

**YOU
CAN DEPEND ON**

CHAMPIONS

THE SPARK PLUG CHAMPIONS USE



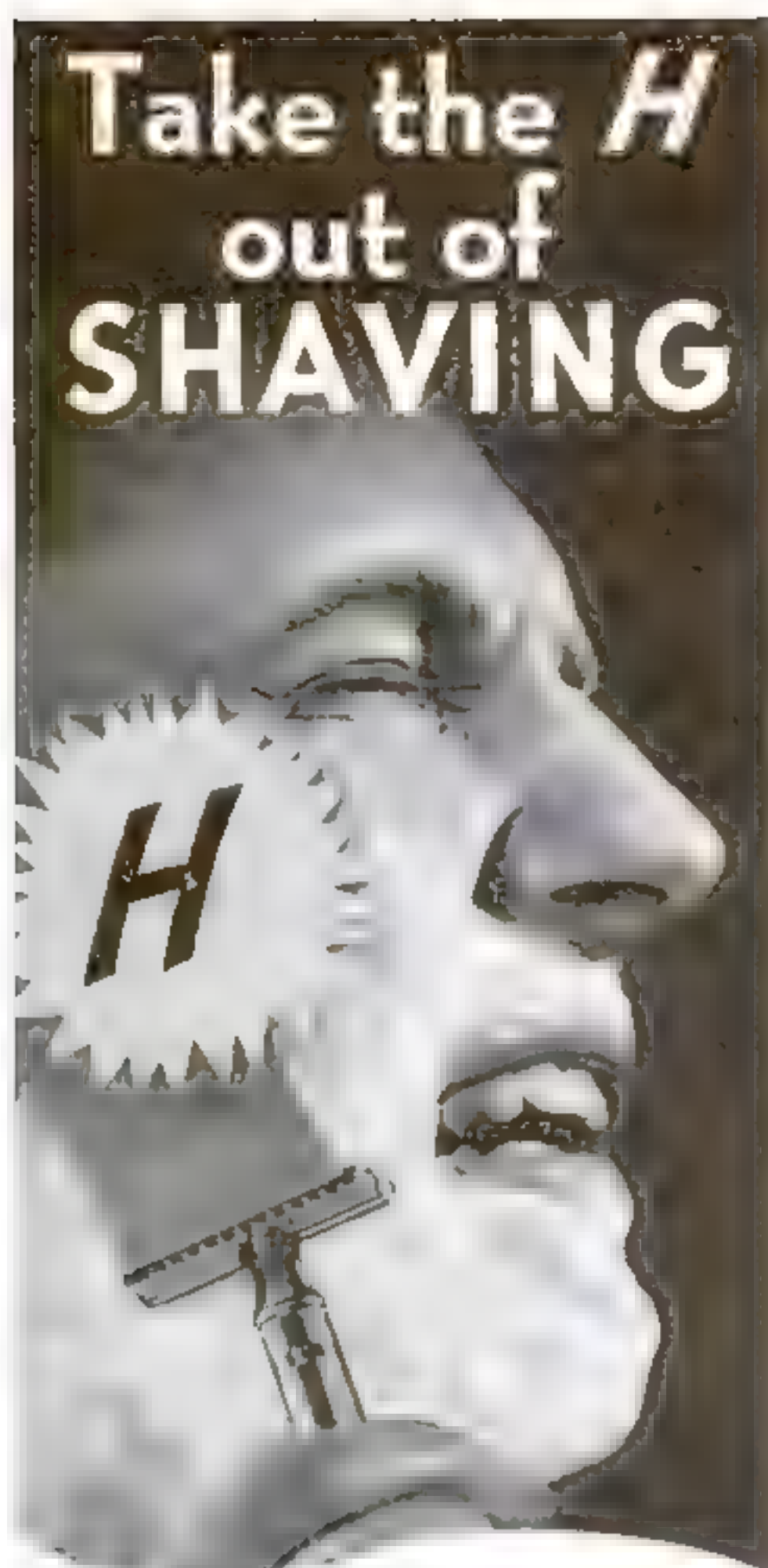
The amount of pleasure you may get from your car during vacation touring depends upon the trouble-free performance of the engine. Engine performance depends to an extraordinary degree on spark plugs.

That is why you find Champion Spark Plugs installed in so many engines. That is also why so many vacation-bound motorists have their spark plugs thoroughly

checked and tested before leaving. Remember, it is a money-saving economy to install new spark plugs every 10,000 miles.

New Champion Spark Plugs will speed your car on its way, with renewed acceleration, power, speed and dependability, and above all, with increased gasoline mileage, which will quickly save their cost. Demand Champion Spark Plugs because you can depend on them.

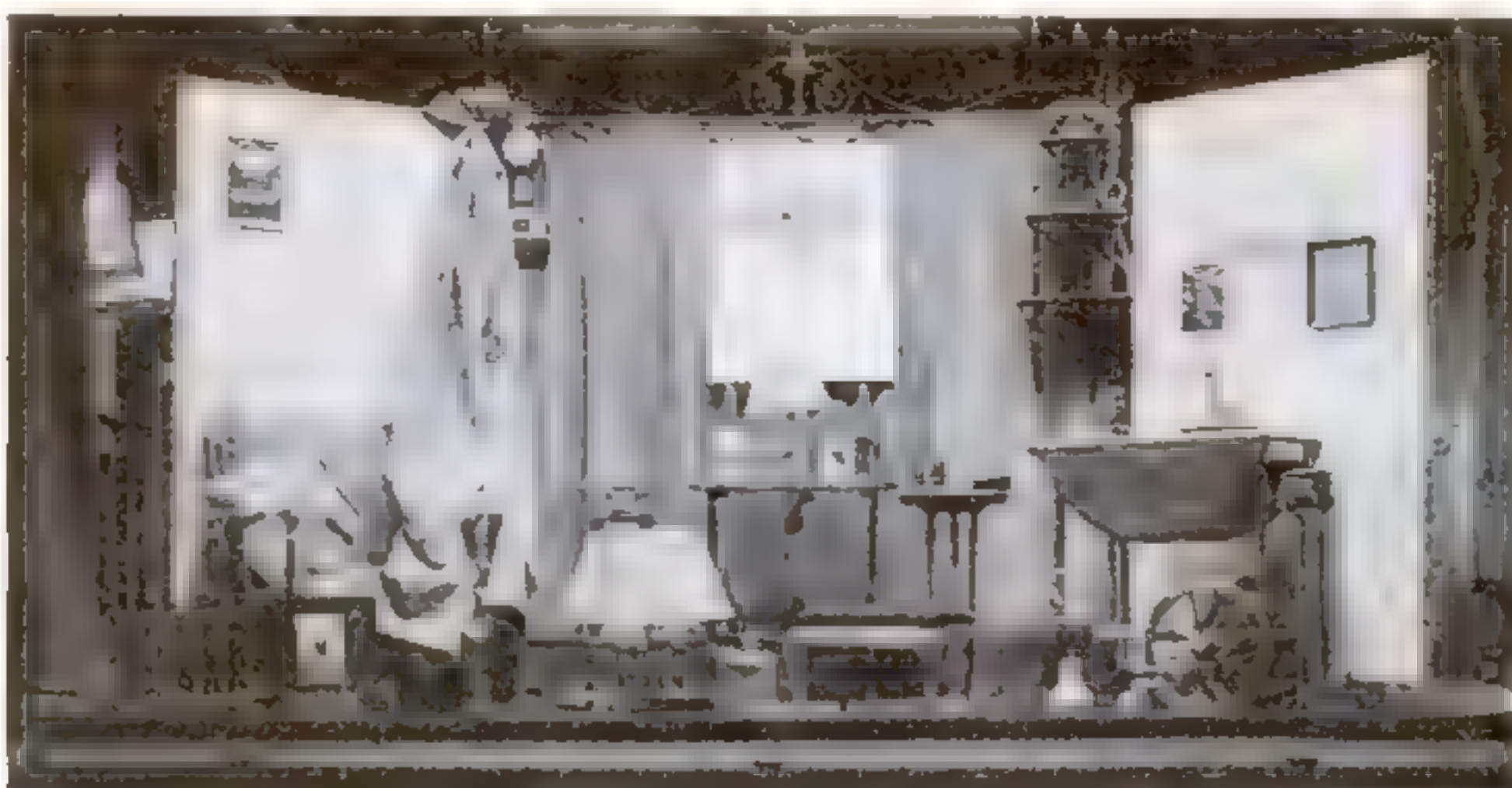
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You owe it to yourself to find out which Mennen Cream fits *your* face: Send 10c for the Mennen Skin Tester Kit, containing liberal demonstration sizes of 5 Mennen Products—including both Lather Shave and Brushless (as well as Skin Bracer, Skin Balm and Talcum for Men). Address Dept. PS-7, The Mennen Co., Newark, N. J.



One of several window displays sponsored recently by the Portland (Ore.) Homeworkshop Club

NEWS HIGH LIGHTS OF GUILD CLUBS

(Continued from page 82)

fit of needy children. The first project selected was the making of bowls.

Two dozen Easter egg holders (see P.S.M., Mar. '37, p. 92) were made by the *Newcastle (Calif.)* Homeworkshop Club and presented to an Eastern Star chapter. They were used as table decorations and then given to past officers of the group.

Seven firms selling home workshop equipment aided the *Wichita (Kans.)* Homecraft and Hobby Club in presenting a ten-day exhibition and demonstration in the showrooms of the local gas and electric company. Miss Marguerite Jorstad, secretary, reports that there were more women than men interested in the show and that the greatest attraction was a jig saw operated by a young woman. Spectators were asked to bring odd jobs which could be done on the machines. F. R. McNeil and H. W. Brewer were in charge.

A 2½ by 10-in. surfacing planer was recently purchased by the *Mexico (Mo.)* Homeworkshop Club and presented to the Mexico High School where meetings are held. By making a small charge to outsiders desiring the use of the machine, the club expects to be entirely reimbursed within a short time. The demonstration of a small motor-driven hand tool was given recently, and moving pictures were shown at another session.

Trailers are being built by William Black and Thomas Deyo of the Passaic County Homeworkshop Club, *Hawthorne, N. J.* The club recently visited the workshops of Mr. Deyo and Robert Ciers, president. Moving pictures were shown at another meeting... The Berkshire Homeworkshop Club, *North Adams, Mass.*, is building two models of the U.S. Constitution from POPULAR SCIENCE MONTHLY plans. Officers for this year are Edward Morrison, president; Daniel Barton, vice president; Everett Barton, secretary... Toys for distribution next Christmas are being made by the *Fairmont (W. Va.)* Homecraft Club... Bird houses were displayed and discussed by the *Ware (Mass.)* Homeworkshop Club at the shop of Dick Gosselin.

Several new members have joined the *Dover (N.H.)* Homecraft Club as the result of an exhibition in a local hardware store. Among the articles displayed were small furniture pieces, an electric glue pot, ski poles of aluminum, copper dishes, pottery, cane seats for chairs, and a diamond-back rattlesnake skin mounted on a board. The club has started a collection of wood samples, and a talk was given on the identification of woods. Moving pictures on steel were shown.

Construction of a band saw, tool benches, chairs, desks, a bed, and other projects were discussed by the *Coulee Dam (Wash.)*

Homeworkshop Club at the home of A. A. Brownson. Mr. and Mrs. C. E. Benjamin entertained the members at another meeting, and Mr. Benjamin exhibited the model of the Grand Coulee Dam which he is building. K. S. Brown projected moving pictures at a third session.

Officers of the *Covington (Ky.)* Homeworkshop Guild for this year are Henry Stark, president; Joseph Hackman, vice president; Gilbert Deye, secretary-treasurer; Charles Zimmer, Jr., librarian. On the board of governors are Louis Schlachter, Arthur Reinschmidt, E. H. Wilkening, and Harrie Johnson.

A wide variety of wooden projects have been donated by many of the members of the Columbia Homeworkshop Guild, *Chicago, Ill.*, to help decorate the club's rooms. Six members are working on a wooden bust of Abraham Lincoln which will be about 2 ft. high. Joseph Fisher has made an attractive case in which to keep Guild bulletins and workshop books. (Continued on page 99)



Hepplewhite chair which won first place in an exhibit given by the Richmond (Va.) club

NEWS OF GUILD CLUBS

(Continued from page 98)

An elaborate exhibition and demonstration sponsored by the *Portland (Ore.)* Homeworkshop Club helped to advertise the home workshop hobby in that city. Hardware stores and newspapers coöperated to make it the biggest thing of its kind ever held in that city . . . Joe Chlopicki exhibited a homemade



Albert Mueller, a member of the Elgin (Ill.) Home Crafters Club, in his home workshop

enlarger to the Capital Homcraft Club, *Washington, D.C.* . . . The Caldwell Parish Homeworkshop Club, *Columbia, La.*, has made a filing case for bulletins and catalogues. S. D. Thomas, president, explained various types of craftwork recently . . . New officers of the Cornhuskers Workshop Club, *Springfield, Ill.*, are H. M. Poppenga, president; C. R. Jones, vice president; R. A. Fash, secretary-treasurer . . . The *Fall River (Mass.)* Homcraft Club visited Leo Ducharme, who owns a completely equipped metal and woodworking shop.

Prizes totaling \$130 were awarded at the annual exhibit of the *Galesburg (Ill.)* Homeworkshop Club, which was the best the group has yet sponsored. Each member was limited to four entries, which had to have been made since Jan. 1, 1936. A recent meeting was held at the shop of John Akeyson, who talked on caning.

The *Brockton (Mass.)* Homcraft Club has been building a curtain rack for the local Y.M.C.A. dramatic group. Radio continues to interest part of the club, and two members have made a code practice oscillator.

A talk and demonstration on photography at home was given by Ralph Leffler at a meeting of the Tri-City Homeworkshop Club of *LaSalle, Peru, and Oglesby, Ill.*

START A WORKSHOP CLUB AND JOIN THE GUILD

HOME workshop enthusiasts throughout the United States, its possessions, and Canada are urged to organize local clubs and join the National Homeworkshop Guild. It costs nothing to belong and enjoy the many free services provided. Complete information on how to start a club, where to meet, how to obtain adequate publicity, and how to prepare a constitution and bylaws will be sent free upon receipt of a large (legal size), self-addressed envelope bearing a three-cent stamp. All inquiries should be made to the National Homeworkshop Guild, 347 Fourth Avenue, New York.

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A sudden leak in the heating boiler—the hammer handle flies off—water squirts from a dent in the auto radiator—a drawer knob pulls out—screws strip from and loosen the door lock—a water pipe freezes and cracks—one caster won't stay in the table leg—your favorite pail starts to leak—a persistently loose nut puts the vacuum cleaner out of business—etc.—etc.

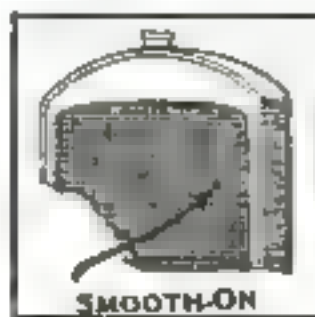
Possibilities like these are ever present to the householder, but invite no delays, repair bills or expensive new purchases if you have a copy of the Smooth-On Repair Instruction Book, keep a can of Smooth-On No. 1 on the shelf and like to prove yourself equal to the emergency.

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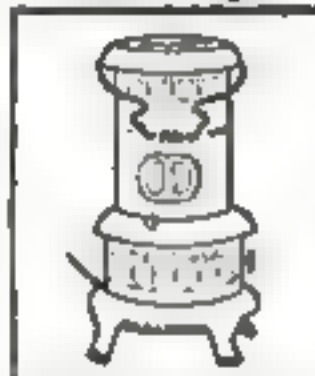
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ARC-WELDING OUTFIT

(Continued from page 87)

through the lamp, therefore it will light to more than normal brilliancy. However, if it is lighted for just a short time, the lamp will not be damaged. Test the remaining coils in the same manner.

Where it is found necessary to splice the wire, either within the coils or at the terminals, it may be done by removing the insulation from each wire for about 1 in. and binding the two ends together with a layer of fine wire, after which the splice should be soldered and taped.

IT WILL be noted that the design of the transformer departs from the conventional method of placing the primary coils on one leg of the core and the secondary coils on the other. The method illustrated follows commercial practice and provides satisfactory voltage regulation, which is quite essential in an arc-welding transformer.

As specified in the previous article, the transformer has a normal rating of 2,500 watts and an overload rating of approximately 4,000 watts. Due to the fact that the current required for various welding jobs will vary over a wide range, some means must be provided to regulate the output of the transformer. Of several methods available, such as a movable core section or taps on the primary coils, a separate reactance coil seemed the most practicable. This method eliminates complicated coil connections and gives a more compact transformer unit.

The reactance coil is shown in Fig. 7 and the photograph immediately below it. The same method of assembling the core is used as with the transformer. The sizes of the core laminations are given in Fig. 8. Approximately 38 lb. of transformer iron will be required.

Since taps are to be taken from the winding, it will be easier to wind the wire directly on the core rather than on a form. The core section should be well insulated before winding to avoid any possibility of the wire's coming in contact with the core. Wind 25 turns of No. 8 D.C.C. (double cotton-covered) wire on the core section and bring out a tap as shown in Fig. 9. Continue the winding, with a tap brought out every 25 turns, until 150 turns have been wound on the core.

ASSEMBLE the core and clamp the ends together as shown in Fig. 7. Provide a terminal strip and connect the ends of the coil to terminals 1 and 7, with the intermediate taps connected to the terminals between.

Approximately 10 lb. of wire will be required for the reactance coil. If it is desired to use No. 10 wire for the coil, the wire should be doubled, that is, two strands should be wound on at once. This makes the winding a little more difficult, but it permits one size of wire to be used on both the transformer and the reactance coil. If No. 10 wire is used, the length of the 5-in. lamination shown in Fig. 8 should be increased to 6 in. to provide additional winding space, with a corresponding increase in the length of the angle-iron and band-iron clamps.

(TO BE CONTINUED)

RAZOR CUT SEPARATES COLORS WHEN PAINTING SHIP MODELS

If it is impracticable for any reason to use masking tape to separate two colors when painting a hull stripe or other decoration on a ship model, make a deep razor-blade cut on the line. The paint is then carefully applied with a small brush, the surface being kept as nearly horizontal as possible. The cut will prevent the excess paint from running over the line. The second color must not be added, of course, until the first is dry.—J. B. N.

Eleven Improvements to Make During JULY

HAVE you ever jotted down a list of jobs you might do around the house and garden during the summer months? There are many home improvements your family would appreciate and enjoy. A few suggestions for July follow:

- Repair broken or loose floor tile.
- Build playhouse for children.
- Install new sink in kitchen or pantry.
- Grade dirt around foundation.
- Redecorate the bathroom.
- Jack up beams where floor has sagged and reënforce, if necessary.
- Calk cracks between wood sills and walls.
- Repaint blistering, cracking, or peeling surfaces.
- Build one or more extra windows to provide more light in rooms.
- Clean efflorescence or scum from brick and concrete walls.
- Install disappearing attic stairway for space economy.

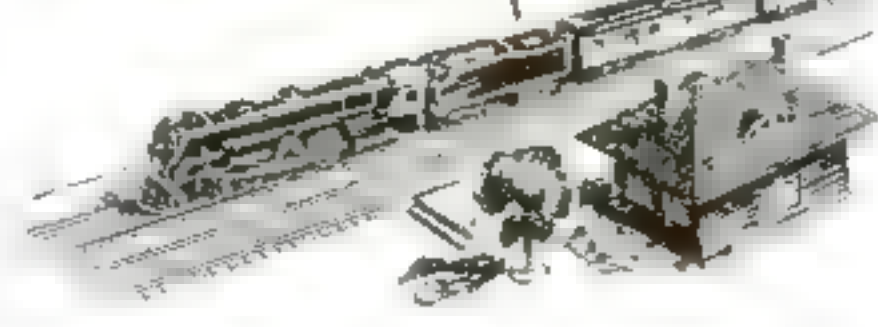
EASY WAY TO STRAIN PAINT FOR SMALL TOUCH-UP JOBS

AFTER decorating a room, most home owners save a little of the paint or enamel for touching up later on. In the course of time the paint "skins" over and cannot be used without straining. To avoid the usual trouble of straining, I merely stir the paint thoroughly, then take a piece of cheesecloth and make a sort of pocket that can be pushed down into the paint, being careful that the paint does not go over the edges of the cloth. I dip the brush directly into the paint which has filtered through inside the cloth pocket. This is especially convenient if two or three touch-up coats are required.—F. CATTNACH.

What's Your Vote ON OUR NEW Locomotive Model?

HERE is model railroading news of the first order. We have developed a simply constructed, powerful scale model of a locomotive that is small enough to run on a table top . . . can be built on a kitchen-table workbench . . . requires few tools and no previous model making experience . . . and, best of all, costs comparatively little for materials. It's just the thing for everyone who wishes to start a model railroad.

Whether we publish this material or not is up to you. We'd like to, but there are a lot of other fine articles awaiting publication, and space is at a premium. If you want the new locomotive, please send a post card right away to the Home Workshop Editor, Popular Science Monthly, 353 Fourth Avenue, New York.



PARTLY OPENED WINDOW LOCKED WITH HINGES

It is often desirable to open a window sufficiently to provide ventilation, yet lock it so that an intruder could not open it far enough to enter. Two small but heavy butt hinges will accomplish this. They should be fastened to each side of the upper sash a few inches above the meeting rail. Mortise them in to the full extent of their thickness so that one sash can slide freely past the other. When it is desired to lock the window in a partly opened condition, open one leaf of each hinge at right angles to the sash. The projecting hinge leaves will serve as stops and prevent the lower window sash from being raised beyond them.—LEE HICKS.

MINIATURE CAMERA CASE FROM A TOBACCO POUCH

THE owner of a miniature camera, particularly one acquired in used condition, may find it difficult, if not impossible, to obtain a suitable leather case for it. At any well-stocked tobacco store, however, it is usually possible to select a tobacco pouch with a slide fastener that will fit the camera as though actually made for it. These pouches are not only of fine material and workmanship, but are usually lined with rubber and consequently afford moistureproof protection for the camera. They also cost far less than a camera case of similar construction.—HARRY RADZINSKY.

PAINTING YOUR BICYCLE

(Continued from page 77)

ing from the joints towards the center portion of each tube. About five strokes are all you will have time for. A clever brush hand will get a perfect job in three—two to lay on and one to tip off.

7. Let dry three days. Sand lightly and evenly with old or used No. 6/0 paper. Moisten the paper back to increase flexibility.

8. Tack-rag off

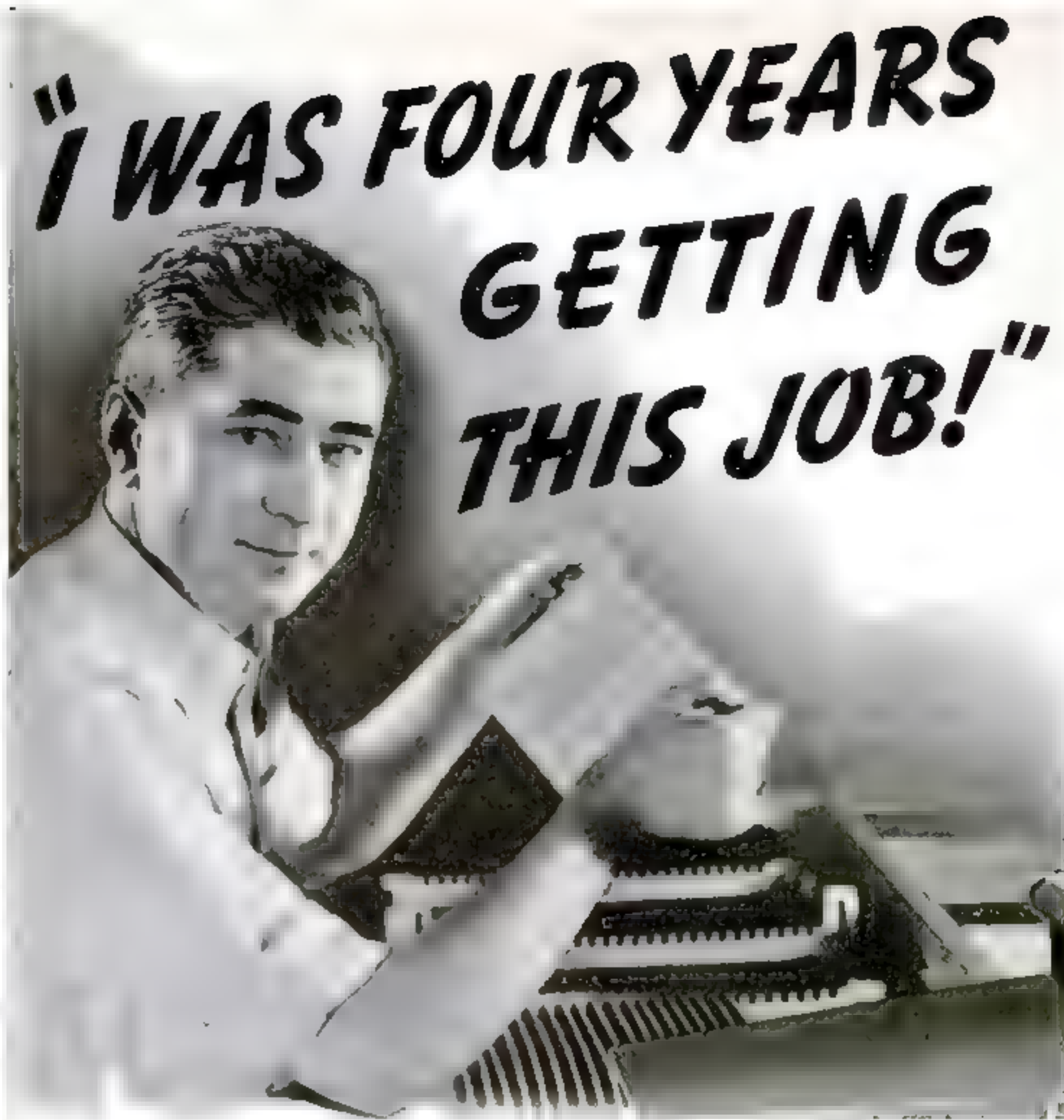
9. Brush on the second and final coat.

10. Dry one week.

Where several colors are used, great care is necessary to cut them in carefully. If this cannot be done free-hand, the lighter color must be applied and dried, and then outlined with ordinary 1-in. 35-lb. paper adhesive tape such as is used in wrapping bundles. The paint is brushed on without lapping over the paper any more than absolutely necessary. After a three-day drying period, wet cloths must be wrapped around the paper strips and left for several hours. The paper then can be peeled off without injuring the enamel beneath. Stripes may be laid by the same method, but it is better either to have that work done by a professional striping or omit it, because striping really takes years of practice.

11. Clean wire wheels and rims with steel wool, alcohol, and clean rags. Polish off rust spots with used No. 6/0 paper and alcohol. Wipe dry. Mix aluminum powder, either in the dry or paste form, with fast-drying spar varnish in the proportion of 4 oz. to 1 pt. or 2 lb. to 1 gal. If dry powder is used, moisten it to a damp paste with turpentine, then add the varnish while stirring constantly. Strain through a single thickness of cheesecloth if necessary. Apply with a soft brush, wipe the brush almost dry on the strike-wire, and cross stroke the spokes on the inside areas; then finish on the outer portions. Brush the rims last. Apply two coats and let each dry three days.

If colored enamel is used instead of aluminum on the rims, the metal should be treated like the frames. In assembling, use a padded and covered stand, and avoid marring the newly finished surfaces with tool marks or scratches.



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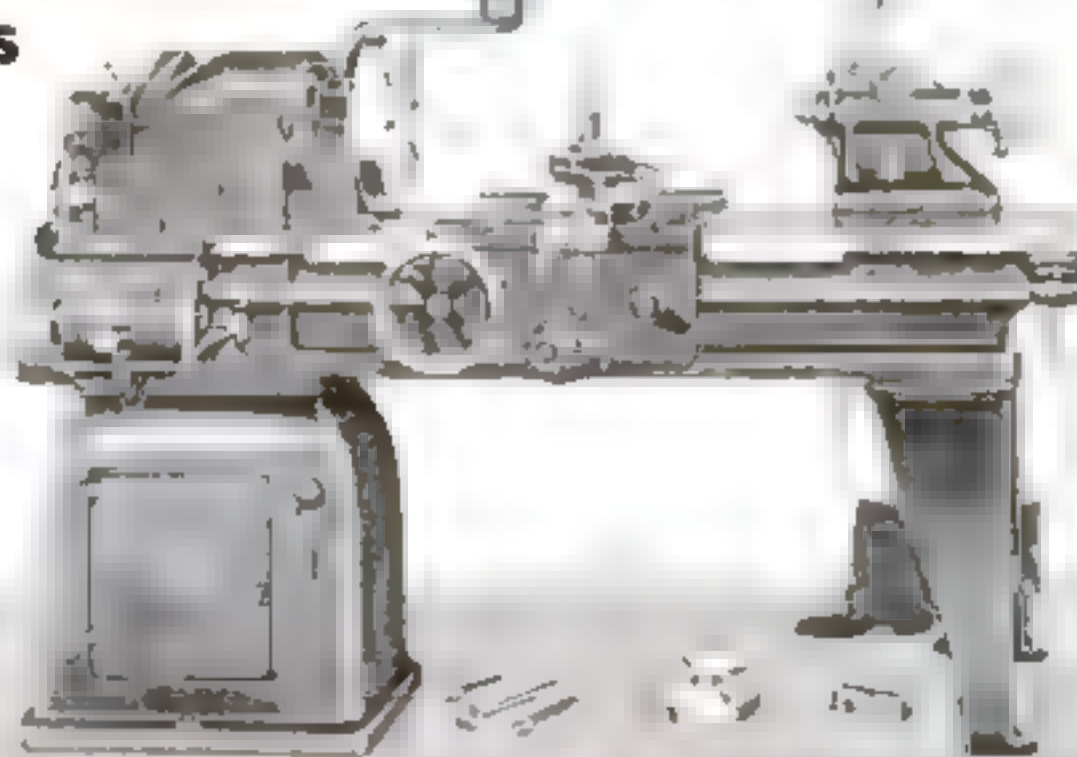
No. 415-YA 9 1/4" swing by 3' bed Workshop Bench Lathe with Horizontal Motor Drive, 1/2 h.p. Reversing Motor, Switch and adjustable belt tension countershaft as shown above. **\$116.00**
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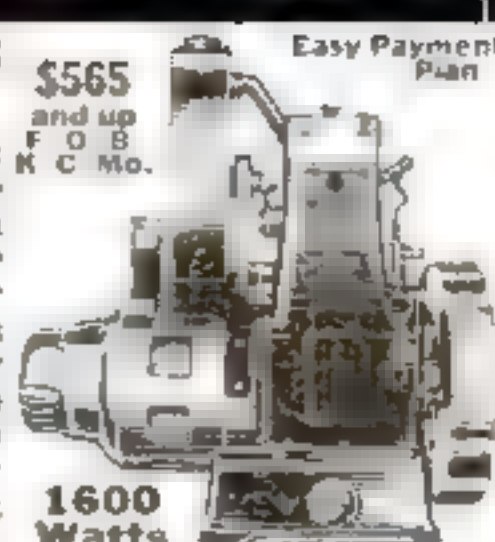
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1600 Watts
\$565 and up F.O.B. K.C. Mo. Easy Payment Plan



NOVEL VOLCANO LEVEES DAM A RIVER OF FIRE

(Continued from page 22)

lets extending like fingers ahead of it. Christmas was celebrated in Hilo with the lava moving nearer at the rate of about two miles a day.

Twenty-four hours later, it was nearing the headwaters of the Wailuku River, the source of Hilo's water supply. Dr. Jaggar telephoned the U.S. Army air base and that night mechanics groomed a dozen big bombing planes for a strange aerial attack upon Mauna Loa. By blasting gaps in the edges of the lava stream, Dr. Jaggar believed he could divert the flow, spread it out and make it cool more quickly, thus building up increased resistance and turning the lava into a new channel.

TWENTY bombs, each filled with 600 pounds of T.N.T. and designed to detonate one-tenth of a second after striking, to allow for penetration, were dropped on the lava stream. Out of the openings torn by this six tons of high explosives, poured the hottest inner lava of the flow. After that, the advance of the molten rock slowed down and finally stopped altogether.

It was during this 1935 eruption that Dr. Jaggar saw something which resulted in his present plan to erect a system of lava dikes on Mauna Loa. He noticed that in several instances natural embankments, lying at an angle to the progress of the lava, turned it to one side. During the first and most dangerous stage of an eruption, the lava moves as a liquid instead of pushing like a solid. By placing his barricades so they slant downhill obliquely, he believes he can divert this "aa type" lava in any direction he desires.

For two decades Dr. Jaggar has been studying tilts and pressures on the lava floors. By means of drills he has taken periodically the temperature of the subsurface rocks. Transit measurements and regular photographic records show minute variations in the shape and condition of the crater. In special containers, he collects gases and analyzes them in his laboratory. Nothing which might throw light upon the mystery of what is occurring underfoot is neglected.

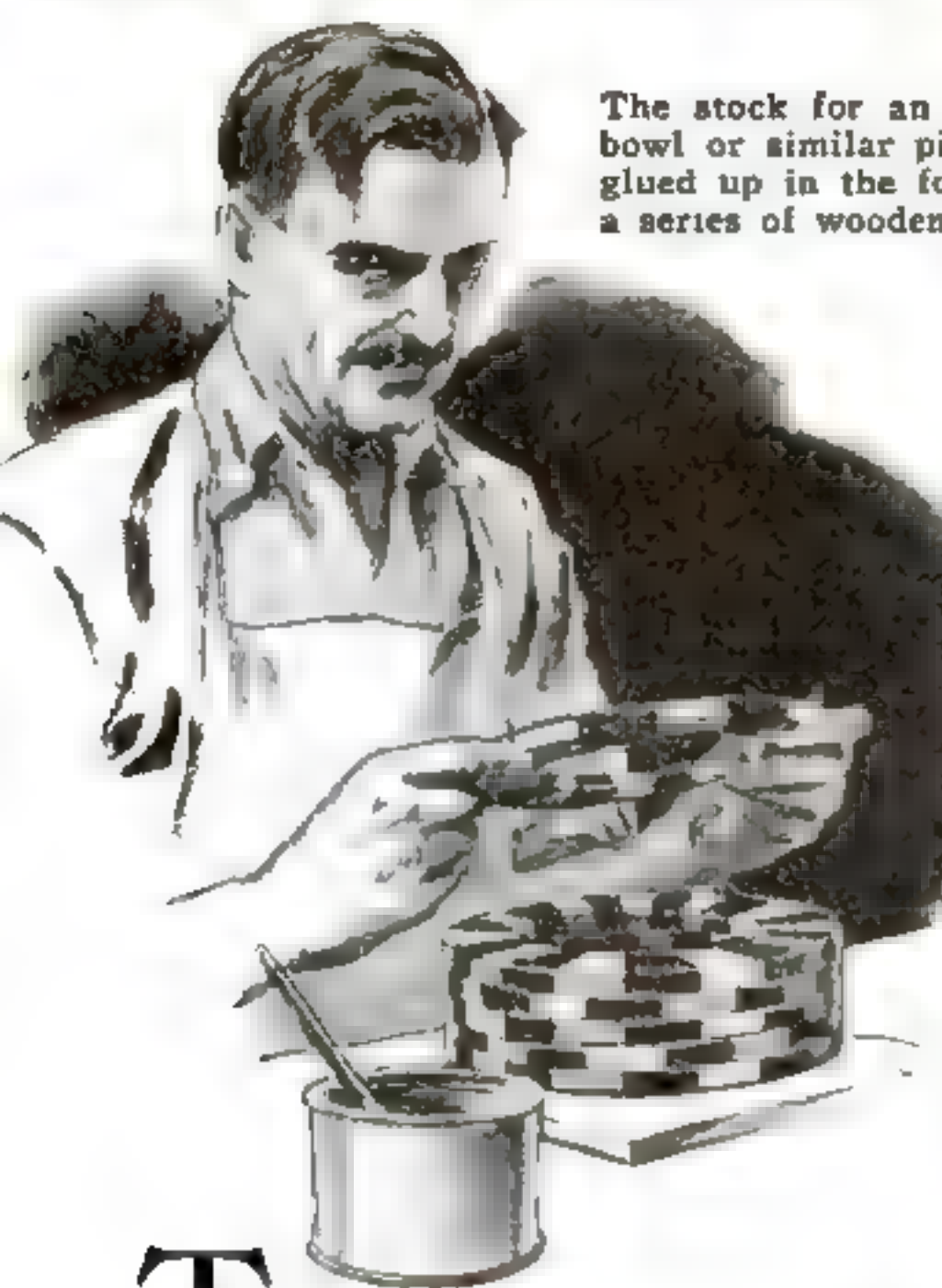
As a result, Dr. Jaggar has been able to predict the last two major eruptions well in advance.

An important part of the harvest of Dr. Jaggar's observatory is a collection of thousand of seismograph records. Earthquakes, volcanoes, and tidal waves are so closely linked together, the scientist points out, that they should be studied jointly in the search for new information about what goes on beneath the surface of the earth. When we know enough about volcanoes, he reasons, we can recognize minute warning signals and thus reduce the annual toll of 40,000 lives now lost in earthquakes and volcanic eruptions.

HIS ultimate goal is a world-wide chain of observatories, manned by experts who will pool their findings just as do the scientists in charge of the far-flung weather bureau stations today. These "consulting specialists" would flash news of unusual activity from any of the sixty-odd live volcanoes on the surface of the globe. Such an organization, modeled after the Rockefeller Institute for Medical Research, would vastly increase our knowledge of the habits of the earth's interior, habits which affect the lives of millions of people.

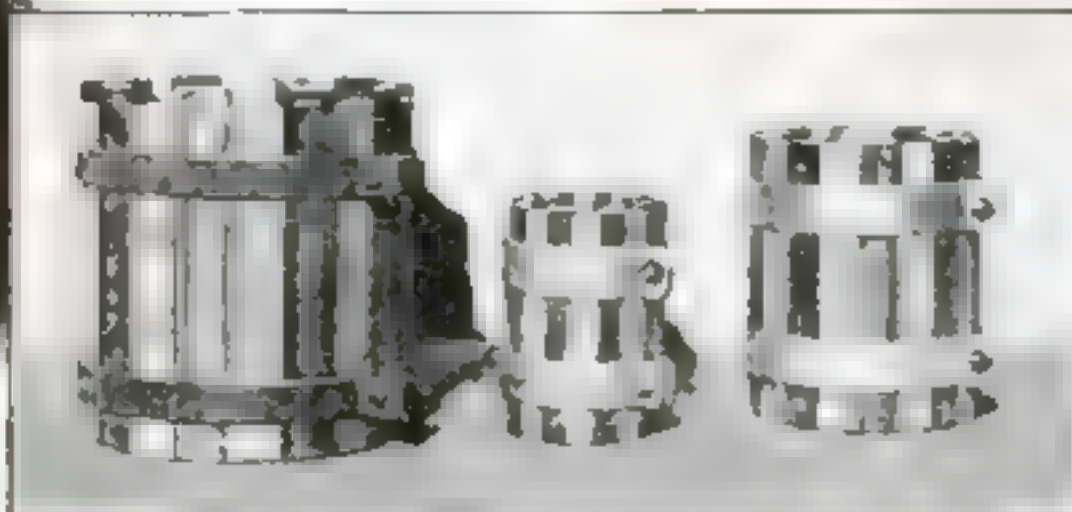
This project, however, lies in the future. The outstanding news of the present is the battle against lava planned for the slopes of Mauna Loa. Unique in the history of man's long struggle against the forces of Nature, this campaign, with its thirteen miles of scientific fortifications, forms the dramatic climax to a quarter of a century of research.

HOW TO GLUE UP WOOD FOR INLAID TURNINGS



The stock for an inlaid bowl or similar piece is glued up in the form of a series of wooden rings

Two inlaid turnings appear at the right. No form of wood turning gives more chance for striking patterns and contrasts in color



The first operation is to glue up cylinders consisting of staves of contrasting woods



The cylinders have to be cut into a series of rings of whatever thicknesses will give the desired effect in the finished product. This is done on a band saw or circular saw

TURNING inlaid nut bowls, trays, vases, lamp stands, and similar work is easily accomplished once the method is understood. Two or preferably more contrasting woods are required. The first step is to draw a full-size layout to determine the angles of the pieces. This is decided by the size of the object and the number of segments desired in the pattern. The trim (circular) saw is then tilted to the proper degree, or if neither the saw nor the table can be tilted, a form can be constructed similar to that illustrated on the fol-

lowing page, using any scrap wood at hand. The material, once it has been selected for color and of the proper width to build up a cylinder long enough to give the required number of layers, is cut off across the grain. These beveled pieces, alternated in color, form the staves of a cylinder, which is glued together with casein glue. To hold the staves for assembly and to provide the proper gluing pressure, it is necessary to improvise clamps. These can be made of sheet metal for small cylinders or wrought from heavy iron for larger work. Both types are shown.

Having been al- (Continued on page 115)

THE TIRE "BLEW..." LIKE A STREAK OF LIGHTNING HIS CAR SHOT OFF THE ROAD



LOWELL THOMAS tells what an unexpected Blow-out did to this New Jersey Motorist

RALPH T. RYAN, JR., of Caldwell, New Jersey, was going East—East on Oxford Road near Montclair, New Jersey. But he almost "went West"—West on that one-way highway on which you can never turn around.

Like most motorists Ralph Ryan took his tires for granted... never dreamed he'd have a blow-out—until BANG! went his right front tire. The car lurched—zig-zagged past a speeding roadster. Seconds seemed like hours before he came to a jerky stop—just in time to miss climbing a tree.

Motorists from every walk of life, thousands of them, are killed or injured every year when blow-outs throw cars out of control.

But a well-known engineer told me that his organization, The B. F. Goodrich Company, in order to provide motorists with the *real* protection they needed against high-speed blow-outs, invented the Life-Saver Golden Ply.

The Golden Ply, as described to me, is a layer of special rubber and full-floating cords, scientifically treated to resist *internal tire heat*. By resisting this heat the Golden Ply keeps rubber and fabric from separating. It keeps blisters from forming. And when the blister is prevented, the great, unseen cause of high-speed blow-outs is "licked."

Taking tires for granted these days seems like a big risk to take.



The *safe* thing to do, I would say, would be to put *safe* tires on your car *before* the damage is done.

Lowell Thomas

Remember, you can buy these life-saving Golden Ply Silvertowns at Goodrich Silvertown Stores and Goodrich Dealers everywhere.



Goodrich SAFETY Silvertown
With Life-Saver Golden Ply Blow-Out Protection

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Don't be discouraged if you are weak, skinny, tired-out, sickly—unable to gain an ounce of flesh or strength no matter what you eat. Doctors now know that the fault often is not with the amount of food you eat. Your daily diet may contain enough potential nourishment of many kinds but unless it contains certain essential minerals, your system is unable to extract full nourishment from the food you eat. The result is you may be eating enough good food to satisfy your appetite and still not be able to gain weight or strength.

In Kelpamalt, the new mineral concentrate from the sea, you can get these minerals so essential to the normal chemical processes of the body in their naturally occurring form. Assimilable iron, copper, manganese, calcium, phosphorus, potassium and magnesium to bolster up the supply of vital minerals needed for digestion and assimilation, the body's weight and strength-building processes! Most important, however, is Kelpamalt's natural iodine (not to be confused with ordinary liquid chemical iodine). Iodine, scientists say, is found in the blood, liver and glands, and is vitally important to their normal functioning.

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MIXING JUNGLE CATS FOR THE CIRCUS

(Continued from page 41)

head. As she leaps, he turns half left to stop the leap and, with her forepaws wrapped around his neck and her teeth apparently sunk in his shoulder, down he goes. But the attack is only feigned, and she slides off as he sinks to the ground.

No stick, whip, or chair defends him in these rushes when she gallops across the thirty-six-foot arena, for Norma looks on the stunt as play. Rather, the trainer finds safety in the fact that the lioness was born in captivity on a southern California lion farm, and never has known the taste of blood in the wild.



Nelson putting a collar on a tiger that is to be brought to the arena for the first time

Of all circus animal tricks, the most difficult and dangerous is the rolling tiger. Breaking a Bengal tiger to crawl and roll over at your feet requires patience, a steady voice, and the strength to hold a chair and long stick in one hand when she tries mightily to slap them aside with one of her massive paws.

Most tigers roll over when a trainer strikes at them, particularly if they are uneasy, ready to fight. The rolling tiger act, therefore, grows out of the animal's readiness to defend itself. To make it more difficult, the trainer must force the animal not only to roll, but also to crawl slowly toward him in the face of the threatening chair.

WHEN Peanuts, who in former seasons had proved herself a capable roller, first entered the arena this spring for workouts, Nelson attached a lunge line to her collar, running the line through an opening in the chair seat. As he called her to come, he tugged gently on the line. Slowly, she edged forward on her belly and when at last her face touched a chair leg, the trainer touched her left flank with the whip, at the same time moving slowly to the right. On the second day, he gave her a slack line; and on the third he removed the lunge line and she completed the stunt gracefully, the habit of previous seasons having been restored to her memory with these brief lessons.

The addition of a new animal to the act often is attended by great danger, to both the trainer and the animals. If the newcomer shows signs of unfriendliness or nervousness, particularly if it is middle-aged and has appeared with another act, it enters the arena wearing a huge leather collar and dragging a chain. Tied to the chain is a thirty-foot rope, which the trainer passes through the bars to three attendants. As long as the new arrival remains in the cage, these men hold

the rope, ready to pull the animal back in case it lunges toward one of the steadier ones.

When Nelson worked the charging lion and the rolling tiger, I noticed that first he ordered the animal to its pedestal, then coaxed it down to perform its routine.

"Why not send them through their paces directly?" I asked.

"No brains," he declared. "Instinct only. They are able to associate ideas to a limited extent, and for that reason the steps they take are never varied. Norma and Peanuts wouldn't have the slightest idea what to do unless I started them from their pedestals. Their dumbness has its advantages, though. A new animal either adopts a favorite pedestal, paces restlessly, or lies down. Wherever he stops, there we place a low pedestal. Soon I induce him to climb up and take a seat. Then we move the pedestal to the point where we want that particular animal to be during the season. Once he becomes accustomed to his spot, I gradually give him taller pedestals until he reaches the height I want. And from that final spot, all his activities are directed."

NELSON, who has been working jungle cats eighteen years, began training animals for public performances at an age when most youngsters are playing with toys. He was seven when he bought a lion cub with part of \$150 he had earned exhibiting trained rats and cats in a Los Angeles theater.

For two years, after school and on Saturdays, he trained the cub to jump through a hoop. By the time he was twelve, he was helping to train animals with a circus. Now, in his early thirties, he can show the scars of 183 scratches inflicted by bears, lions, tigers, pumas, and leopards; yet not one was suffered in an attack. All resulted from accidents.

Nelson considers himself an animal trainer, not a tamer, for wild animals are never tamed. By repeated rehearsal, they come to react mechanically to the various cues. It may be a facial expression, a movement of a whip or stick, or motions and positions of the arms and body. These beasts roar and snarl, spit, and slap out with their great paws; but each snarl, rush, and lunge has been carefully rehearsed. They're only part of the act.

By the time the season opens, the trainer told me, the animals know their parts as well as human actors; and when at last bands blare and they race softly down long wooden chutes into the iron-barred arena, they face a trainer armed only with a short stick which he wields like a schoolmaster in pointing out the animals from which he expect immediate obedience to his cued commands.

"Suppose they do not obey quickly?" I asked, as I peered through the bars. "How do you know what to expect?"

"There's never any doubt about their plans," Nelson explained, puffing from the exertion of having faced three of Norma's leaps. "Any of these cats will signal his intentions when about to attack. For that reason, a trainer is safe unless he finds himself caught in a general rough-house, turns his back at the wrong instant, or falls."

"BUT, speaking of danger signals, did you ever see a house cat's eyes when it's about to pounce on a mouse? Well, when one of these jungle cats takes a notion to charge, I see a cold gleam come into his eyes. He moves his head solemnly to one side, his tail lashes stiffly across his back—and out I go through the safety gate."

It was in the Chicago stadium that a cage full of lions and tigers once proved how quickly an evil *(Continued on page 105)*

MIXING JUNGLE CATS FOR THE CIRCUS

(Continued from page 104)

temper can be translated into violent action. It seems that the animals run in gangs. Jug Head and Caesar belonged to one gang, and for some reason Caesar took a sudden dislike to Teba, a tiger.

Sixteen animals had entered the cage, and Nelson had called for the seventeenth, which happened to be Teba. The audience of 20,000 sat in silence as the animals roared and snarled. Jug Head and Peanuts were uttering disquieting sounds, which only Nelson and his assistants understood, while Caesar sat as still as a mouse. Teba entered sedately, walked to the front, stopped, and turned, preparatory to leaping to her low seat.

At that instant, Caesar pounced from his pedestal, struck the ground and leaped again toward Teba. On the second jump Nelson raced to the safety gate, while Jug Head and the rest of his gang roared down into the fray. In a split second, the entire cage seemed to cave in, in the middle.

THROUGH the bars, trainers fired blank cartridges, poked with long sticks, and shouted. For ten minutes fur flew and blood flowed. Remember, lions and tigers were there in equal numbers. Which came out first? The tigers. As soon as they went out through the chute to the line-up cages, Nelson herded the lions out. Next day, after the wounds had been sprayed and cauterized, all the animals went on with the show as though nothing had happened.

"I think I got the worst of the bargain," the trainer told me, "for I sprained a wrist knocking two lions out of the road on the way to the safety gate."

On another occasion, such a mêlée almost cost Nelson his life. Star, a five-year-old royal Bengal tiger, whose habit it was to start fights, snarled once too often at Bessie, an old lioness at the top of the pyramid. Bessie leaped on Star, grabbing her by the throat. Jug Head and Peanuts leaped into the fight. And the roaring, snarling animals fell against the trainer. With his whip he beat Star off, when Jug Head turned on him. He grabbed the ever-present chair, thrust its four legs in the lion's face, and slipped out through the gate.

It has long been an axiom that anyone can "stare down" an infuriated animal simply by gazing steadily directly into its eyes. This is a mistaken idea, according to Nelson, who told me that such an attempt in an arena would invite immediate attack.

"Since tigers and lions possess one-track minds," he explained, "staring back only serves to rivet attention upon the eyes. Whenever I catch one eyeing me maliciously, I immediately look the other way. He then thinks I have no interest in him, and abandons whatever designs he may have had. This explains why trainers keep a chair handy. The four legs confuse a charging cat, and in trying to decide which of the four to slap down he forgets his plan to attack."

SELDOM does a jungle cat escape from an arena during a public exhibition, to charge madly through the audience. But if that should ever happen when you are present, here's a tip: Remain absolutely silent and motionless.

Any captive wild animal becomes excited when he escapes confinement, Nelson told me, because freedom is very strange to him. Actually, they prefer their cages to the open. Should one come by and you have a cane or stick handy, thrust it before his face and he will lose interest in you in favor of the moving object. Better yet, just sit still and wait for the trainers to attract him with chairs or sticks.

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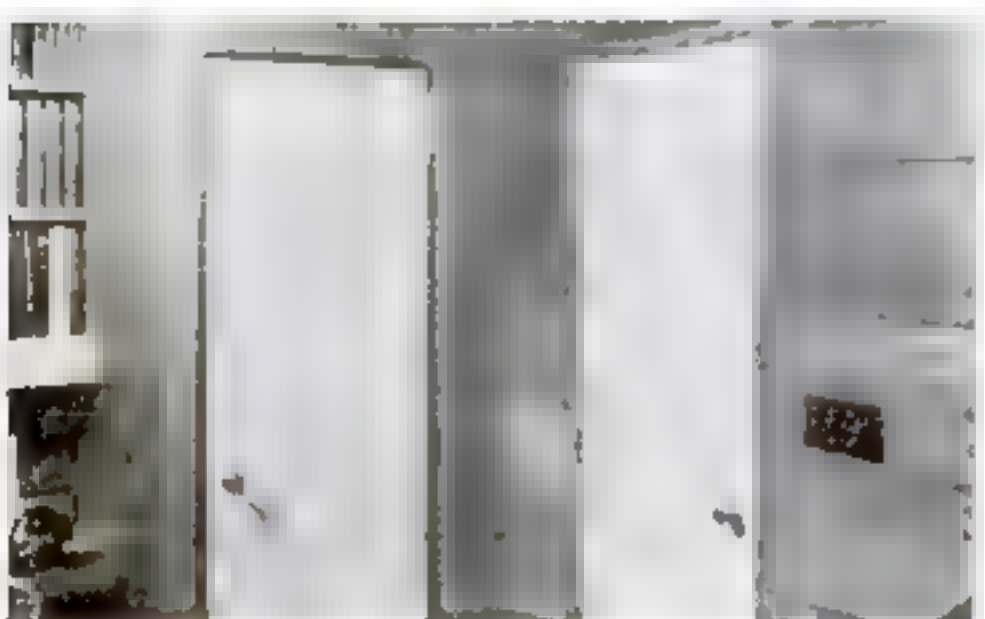
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(Construction kits are available for some of these models. See page 17.)



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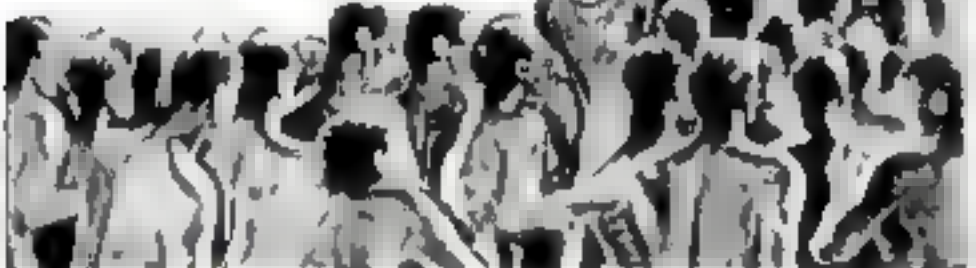
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MASTER BUILDER OF SPEED

(Continued from page 31)

the thrills, the superlatives. How are the records made possible?

You will find Offenhauser on the side lines checking and rechecking engines of various drivers to make sure they are ready to burn up the track, surely and economically.

When Petillo, for instance, found his motor was consuming gasoline at a too-lively rate, Offenhauser connected a cable between the dashboard and carburetor, with which the riding mechanic closes off the idling jets at high speeds, opening them when the car comes into the pits.

THIS master builder never permits an engine to enter a race until it has been thoroughly and completely tested, not on a block but on the road or track. This year no premium fuels were permitted, all drivers being required to use "standard" gasolines, meaning those which have been selling to the public at least a year. Thus, engines were rebuilt this spring, pistons and cams strengthened.

Where formerly a compression ratio of fourteen to one was common, this now has been lowered. On a dirt track near his plant, Offenhauser tests his engines to determine the maximum compression he dare employ before the engine "pings," or detonates with a bang.

Offenhauser uses only metals which have been thoroughly tested in recognized laboratories. Not only does he make his crankshaft of nitrolloy steel, but after machining it he heat-treats the finished product in an air-tight oven in the presence of ammonia gas. This makes the shaft so hard that he actually can cut glass with a sharp edge, a feat impossible with ordinary, tough tool steels.

Connecting rods of chrome-vanadium steel are first rough-machined, then heat-treated to make them tough, and finally are finished by machine. A high-tin-content Babbitt metal lines the crank-pin end, while the wrist-pin end is fitted with a hardened steel bushing.

"We found in the past that bronze burns out under the high compression," he explained.

The Indianapolis classic has contributed far more to motoring than a thrill for the thousands who witness it. This race is the crucible from which, sometimes at the cost of human life, come scientific and mechanical developments that make for greater comfort and safety on the highway.

I asked Offenhauser what he considers the greatest contribution of racing to motoring in general.

"Begin anywhere you like," he replied. "Four-wheel brakes were used at Indianapolis five years before the public got them. Thanks to racing demands, you have tires which will give service 20,000 miles or more. Antiknock fuels were tested first on the track, and as a result you have higher-compression engines.

"UNIVERSAL joints which will stand both speed and heavy pulling were developed in racing cars. Also, carburetors which give a gasoline mileage once thought impossible. High-pressure oiling systems guaranteeing lubrication to all parts, shockproof steering, and shock absorbers came from the Indianapolis Speedway, partly because the boys could not stand the bumps. Springs, once long and comparatively unyielding, have been replaced by short, flat springs which make riding a pleasure on rough roads. The racing drivers who first tested them made possible these luxuries and economies on modern automobiles."

While Offenhauser's fame as a builder of racing motors was skyrocketing, the midget-car craze swept the nation. Four years ago the first of these peewee racers, powered by ancient motor-cycle and outboard engines, roared around a (Continued on page 108)

STERNO CANNED HEAT



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KEENIZER PRODUCTS

Fostoria, Ohio

MASTER BUILDER OF SPEED

(Continued from page 107)

flat dirt track at Los Angeles. For two years, youngsters, coaxing speed from frail chassis and power plants of more than dubious reliability, risked their necks for small purses.

Then Offenhauser motors placed one-two at Indianapolis, and Earl Gilmore, California oil man, who had built a stadium to accommodate the throngs that sought admittance to the midget races, came to this master craftsman with a demand.

"We must keep the show moving," he told Offenhauser. "Twelve cars start, and two finish."

Offenhauser built a sleek little motor, one capable of turning up 7,500 revolutions a minute to pour 150 horsepower out from the ninety-seven cubic inches of displacement within its four cylinders, collected \$1,200 for the power plant complete to clutch and transmission, and turned it over to Curly Mills, one of the midget stars. That was in September, 1935. During the same month, he delivered the second engine to Bob Swanson, another young ace of the midget pilots.

"SHE'LL do ninety-five," Offenhauser cautioned Mills. "Don't try to open her up on those straightaways; and don't gun her too quickly, or you'll skid."

Mills took the engine, entered a race later that week, and won. Since then Offenhauser has built twenty-one motors for the midgets, and has lost only three races in the hundred or more his baby speed plants have entered.

"These events," he told me, raising his voice above the whirr of machines turning out parts for the larger racing cars which a few days ago faced the starter's flag at Indianapo-

lis, "are tougher on cars and engines than the big races. Meyer and Petillo, to take a couple of the leaders, go into a turn easily, never varying the speed of their engines more than 1,400 revolutions a minute. But the midgets! They roar down the straightaway, scarcely one sixteenth mile long, jam on the brakes, slow to 2,300, then jam the throttle down and wind up to 5,300 revs at the drop of a hat. Remember, too, this happens twice every time they circle the quarter-mile track."

Oddly, the baby is running away from the parent. This year, \$150,000 in prizes is being offered at various midget tracks, whereas the total offered winners in the major large-car racing events falls short of that amount. In ten weeks, according to Offenhauser, a good driver can place in the money often enough to pay for his car and engine, cover all operating and travel expenses, and save \$5,000.

BUT the speed builder's heart is in big-car racing, and for six months each year he works fourteen hours a day fitting parts to a split hair breadth, so that they may not fail when put to the crucial test. He uses no stock parts, and machines every piece, from block to lock washers, to specifications taken from blueprints.

Once assembled, his motors give greater speed than any yet built. What is the secret? Offenhauser would have you believe that his success lies in the use of proper materials of the proper weight at the proper places. He neglects to add that for more than two decades he toiled without recognition, acquiring the experience and skill that drives his creations across the finish line ahead of their rivals.

AMAZING CAMERAS BUILT AS A HOBBY

(Continued from page 43)

enlarger, so Rivero built one. A novel feature is the reflector, made of sheet metal, nickel-plated to increase its reflecting power. Rivero calculated the curves of its parts carefully, so that the reflecting surfaces are segments of ellipses. The reflector, working in conjunction with a condensing lens, produces even, intense illumination on the negative. A 100-watt lamp is too powerful to use with it for ordinary bromide enlarging paper.

SEVERAL developing tanks, all homemade, are to be found in Rivero's garage-corner darkroom. Each of the tanks has one or more features setting it off from ordinary tanks of similar type. There is one developing outfit that will handle film from vest-pocket (1½ by 2½-inch) size up to 3¼ by 5½-inch rolls, and vest-pocket and 2¼ by 3¼-inch film packs. It has a spiral-grooved reel, in which film is held at the edges only, and which Rivero patiently fashioned, on a homemade jig saw, from pressed-fiber building board. He is planning a new spiral-grooved reel, to be made of waterproofed cardboard.

Another tank, made of cardboard and wood, and waterproofed with a celluloid solution, has an ingenious valve for emptying, a thermometer well on the side, and stainless-steel bearings for the film reel. This tank is used in conjunction with an agitator made from an old fan motor.

As Rivero's leg injury became better, and his camera-building activities progressed, he added to his tool collection. He made a small lathe on which he can turn wood and metal. He is constantly expanding his collection of hand tools by making new ones.

Rivero is not the type of hobbyist who makes something and then puts it away on a shelf to collect dust. His miniature camera has had steady use. In fact, its first coat of enamel

has worn off, and the second one is going fast. And if something were to go wrong with the mechanism, he wouldn't have to ship the camera to a factory for repairs; he simply would get out a screw driver and fix it himself.

The miniature camera is unique in a way that reflects Rivero's engineering training. He worked out the design on paper, and was so certain of it that he completed the job entirely, finish and all, without preliminary experimenting. And the camera worked perfectly from the first shot, except for a few film scratches, which were eliminated by changing the pressure-plate arrangement that holds the film flat. Since the camera was finished, he has never had to go into its works. He has thought of speeding up the shutter, but hesitates to disturb the setting of the shutter springs while it is working so well.

THE miniature camera was not his first camera-building venture, but his third. When he first was looking around for something to keep him occupied, he got hold of an inexpensive "watch camera"—a contrivance shaped like a watch, with a lens in the stem, and using narrow strips of film. This camera did not work well, so he rebuilt it. He re-focused the lens, made a new film magazine and spools, and constructed a splitting device for cutting strips of standard film into ribbons that would fit the camera. When he got through, the watch camera was capable of making really excellent pictures, as his album proves.

Then he felt the need for something larger and more flexible. A 3¼ by 4¼-inch film-pack camera of somewhat ancient type came into his possession. It had almost no virtues except a usable lens and shutter—no adjustments except those barely essential, and no focusing back. So (Continued on page 109)

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AMAZING CAMERAS BUILT AS A HOBBY

(Continued from page 108)

Rivero started to work on it. He cut it down to 2 1/4 by 3 1/4-inch size, made a film-pack adapter and a ground-glass focusing screen for it, built a rising-and-swinging front out of aluminum, and made a new bellows twice the length of the old one, so that close-up objects could be focused. To focus the camera, he made a rack-and-pinion bedplate mechanism; and he cut the teeth in the rack by hand, with a hack saw!

"Most amateur photographers," he says, "could get even greater enjoyment out of their hobby if they would build their own equipment. I had to make my own, because of cost, but I found that it is as much fun to build a camera as to use it."

"And for the benefit of those who claim lack of space for the pursuit of their hobbies, I might mention that my small garage holds a ten-foot workbench, a darkroom, and other various and sundry junk—besides housing a car at night!"

Rivero's collection of cameras, enlargers, developing tanks, and tools—all made with his own hands, with little more to start with than a lot of time to kill and a vague idea—ought to serve as an example to other craftsmen who think that they need a completely equipped laboratory or shop in order to do anything.

Imagine yourself building a miniature camera of watch-like precision while lying on your back in bed, and you have some idea of what Horace Rivero has done. He longs to get back to his engineering, but never will lose his interest in photography.

SHORT-WAVE SET IS TWO RECEIVERS IN ONE

(Continued from page 69)

between the knob and the condenser shaft, however, is advisable in order to avoid any possibility of troublesome "hand-capacity" effects.

Six plug-in coils are necessary to cover the range from four to 200 meters. The two for the superregenerative detector should be wound on special ultra-short-wave coil forms. For the ordinary regenerative detector, however, the builder may use a commercial set of four-prong coils or wind his own on tube bases or small-diameter coil forms. Specifications for the windings are given in the coil chart.

An alternating-current power pack is used to supply all the necessary voltages for the receiver. It furnishes six volts for the tube filaments and approximately 180 volts for the plate circuit. Resistor (R₁) improves the filtering and keeps the plate voltage at a reasonable value, while the mica by-pass condenser (C₁) eliminates tunable hum. Incidentally, this power supply also is ideal for use with the popular five-meter radiophone described in a recent issue (P.S.M., Dec. '35, p. 54), and answers the requests of many readers who have expressed the desire for a diagram of a suitable unit.

The tuning technique to be followed will depend upon which detector is switched into the circuit. With the ordinary regenerative detector, stations are tuned in with the regeneration control advanced to a point where oscillation begins. Then the control can be "backed down" until the whistle stops and the desired signal becomes intelligible. For superregeneration, however, the regeneration control should be adjusted until there is a strong hiss heard in the earphones. When a station is tuned in by rotating the condenser, the hiss will diminish or drop out completely, depending upon the strength of the signal. Usually the same setting will suffice for both the regenerative and the superregenerative detectors.

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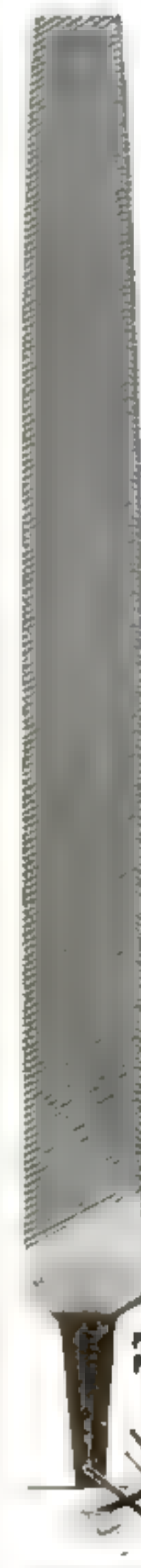
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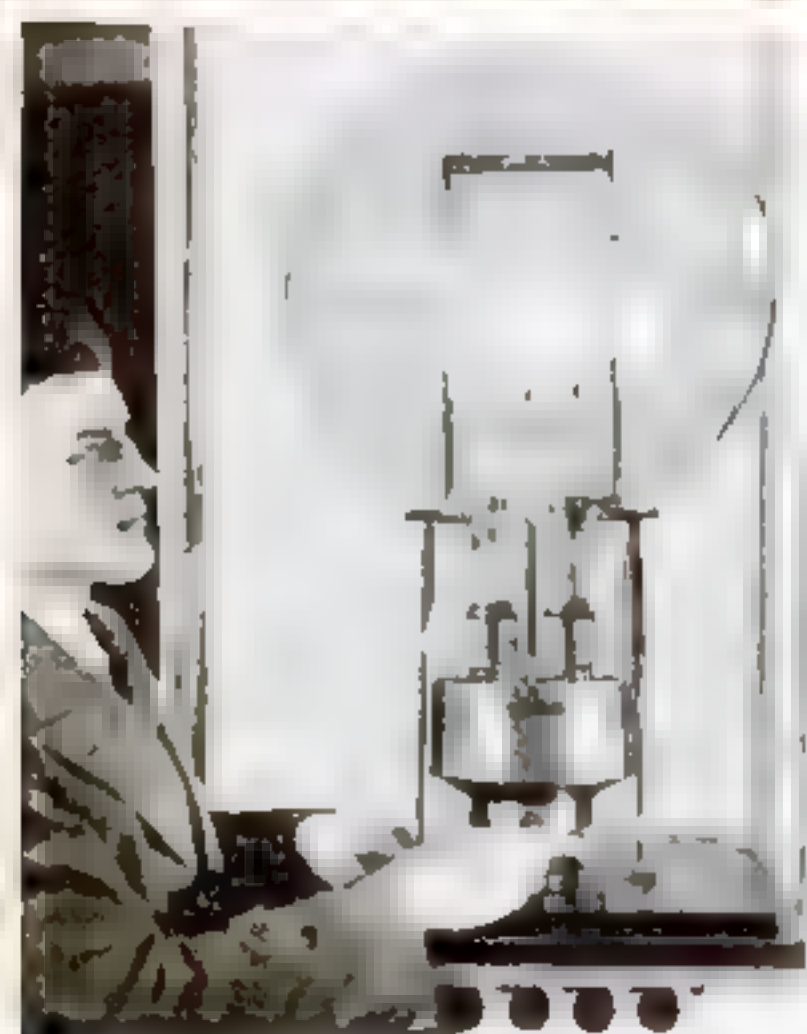
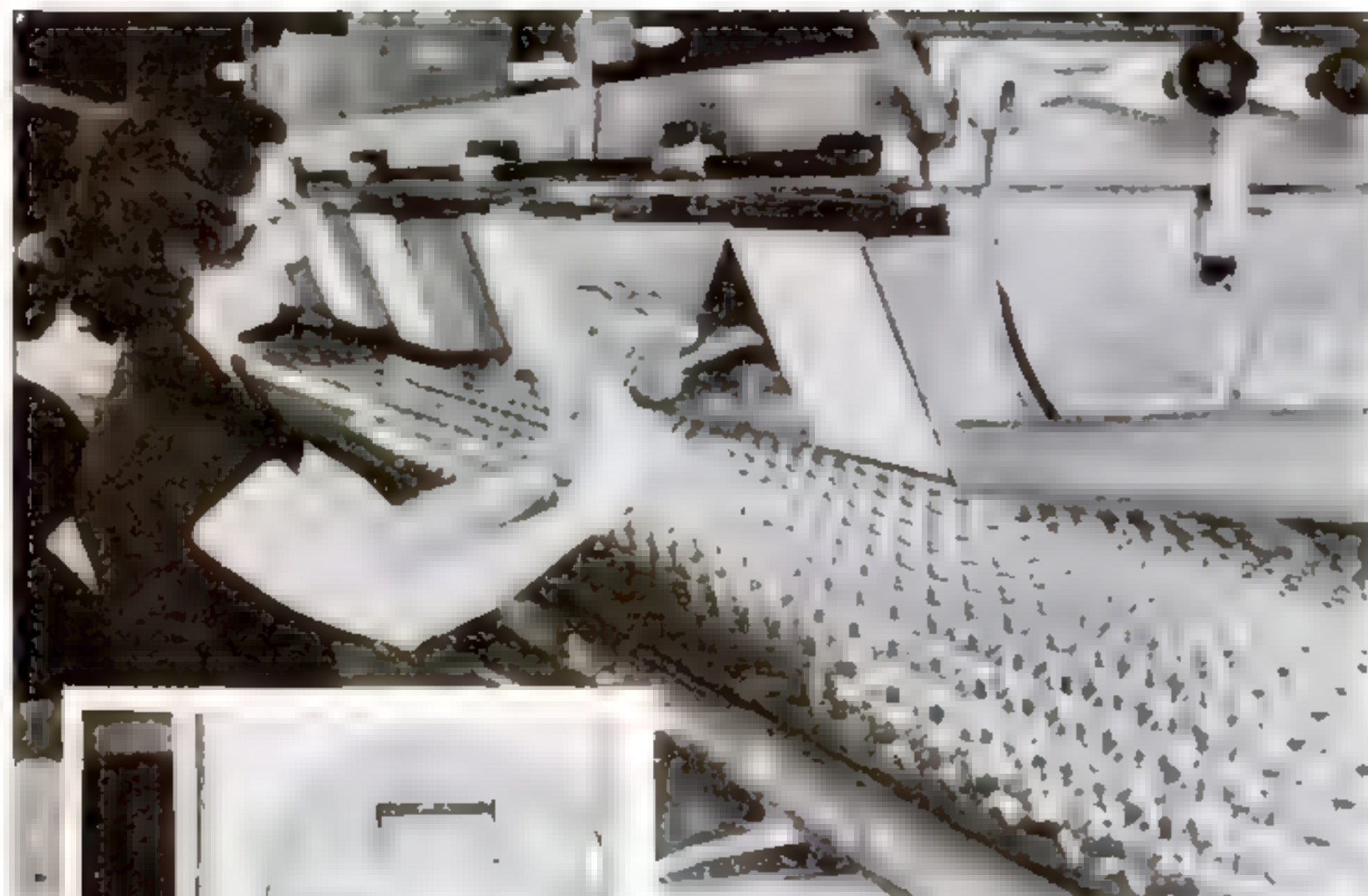
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Now Let's See WHY LIGHT BULBS LAST SO LONG

PROBABLY you don't give much thought to your electric light bulbs nowadays . . . except on one of those infrequent occasions when a lamp burns out. Yet it wasn't so terribly far back that bulb replacement was quite an item in the family budget and people *did* think about it.

Perhaps you have a pretty good idea of why today's incandescent bulbs last so much longer, but do you really *know*? Do you *know* why they give better light and cost so much less? We weren't altogether sure ourselves until a "Popular Science" cameraman went to Nela Park, Cleveland, and got the whole story "in the box." And it is a story . . . a most absorbing one.

See it and hear it in the newest release of "Popular Science"—Paramount's fascinating series of sound and color shorts—when it comes to your neighborhood theatre. Or ask the manager to book it. See, too, the miracles of plastic surgery, the world's largest camera, tricky new living room furniture, how science has made the life of the ant an open book to everyone. Here's a movie that not only you but the whole family will enjoy.

Produced in Cinecolor by Carlisle & Fairbanks with the co-operation of the editors of Popular Science Monthly

A Paramount Picture

DOES YOUR CAR HAVE NEW-TYPE BEARINGS?

(Continued from page 70)

a bearing, and in some ways a better one, by the modern method."

"Well, if that is just as good a way to make bearings, why wasn't it done before?" Walton grumbled. "Surely, bearing makers didn't go to all the trouble they took to anchor the bearing metal just to amuse themselves, did they?"

"They did it because they hadn't found out how to make a loose bearing shell that wouldn't pound to pieces," Gus replied. "You couldn't make sections of bearing like this out of Babbitt metal and get away with it. Watch this."

GUS picked up one of the old bearing sections that Walton had removed from his car, and pounded it with a hammer. Instead of smashing, as it would have done if it had been made of pure Babbitt, the bearing merely bent.

"The secret of the new connecting-rod bearings is in knowing how to coat steel with Babbitt metal or one of the other new bearing metals they are using nowadays, such as copper-lead and cadmium-silver alloys, and also in learning how to make the parts so accurately that the fit will be right without any handwork."

"You remember how," Gus continued, "when you used to scrape in a connecting-rod or main bearing, you always shimmed it after you finished scraping, so that the shaft would turn easily? You did that so there would be just enough play to let the oil get into the bearing."

"And how do they get around the need for scraping now?" Walton asked.

"I was coming to that," Gus smiled. "In the first place, they've developed machinery for finishing the bearing surfaces of a crankshaft by grinding and then by lapping, so that they are dead round—as smooth as glass, and true to size to a fraction of a thousandth of an inch. The same thing applies to the connecting-rod bearings. So your shaft size and the connecting-rod big-end size are exactly right, and the surface is mighty near perfection. The floating bearing is steel, with a heavy layer of Babbitt or one of the new bearing metals put on so that it can't possibly come loose. All you need to do is to make the bearing section exactly the right size to fill the space between the outside steel surface of the shaft and the inside steel surface of the connecting-rod, with the proper amount of play to provide for the flow of oil, and you have a bearing that can be renewed in just a few minutes by slipping new bearing sections into place."

WALTON gazed solemnly at the mirror-like surface on the inside of the big end of the connecting rod, then crawled under the car and ran his finger over the shining steel of the crankshaft.

"I should have doped that out for myself," he grumbled, as he got to his feet again. "How do these bearings stand up?"

"As well as the best hand-scraped job, considering that motors now run at much higher speeds than they used to," Gus replied. "Of course, bearing wear depends on lubrication, mostly, and there's where the modern car shines, with oil being forced into the bearings under pressure every second the motor is running. As a matter of fact, the use of pressure-feed oiling was one of the things that helped along the standardization of bearings. You see, the pistons are lubricated by the oil that is constantly being forced out of the connecting-rod bearings and flung all over the inside of the engine. Naturally, the amount of oil that comes out of a bearing depends on how much play *(Continued on page 113)*

SIMPLE HINTS ON SURFBOARD RIDING

(Continued from page 25)



In rescuing a helpless swimmer, it is best to straddle the board while dragging his weight

speed of the swell. As the stern lifts, throw your weight slightly forward in order to gain a final impetus for the slide. If all is well, you now will start to glide down the slope of water, just as a toboggan speeds down an icy hillside.

Once under way at a pace that drives wind and spray whistling by your ears, your first maneuver is to "slide," or angle to one side, away from the break of the wave. This may be accomplished simply by shifting your weight and, if the board fails to respond instantly, using a foot as a rudder. Failure to come into a slide sometimes causes a board to dive, especially on steep waves. On this initial ride you probably will be content to maintain a prone position, but continued practice will eventually find you standing on the speeding plane.

Many riders come to their feet in a single movement, holding the board steady with their hands. The beginner, however, probably will feel more secure if he first draws his knees beneath him. An erect wave rider generally has one foot slightly in advance of the other, in some cases standing almost sidewise to the direction of travel. Like a tight-wire artist, you may have to use your arms vigorously in balancing.

GUIDE your sensitive craft by shifting your weight from side to side. If the bow appears to be dropping, take a short step backward to alter your balance slightly. Conversely, a step or jump forward will tend to lower the bow and send you farther down the slope of the wave. A zigzag course can be maintained by careful steering. Expert wave riders have been known to dart in and out among the mussel-crusted pilings of a pier while standing erect and steering solely by balance.

At length, you approach shallowing water and the point where all waves must break. To prevent any mishap in the breakers you will "cut out." Step well back on your board and, as the bow lifts, lean sharply to one side. This will allow the wave to pass on beneath you. Once you have escaped a wave, however, be quick to paddle seaward again, lest you be mauled by the following breaker.

Sometimes a rider is able to survive the break and continue his ride clear to the glis-

tening sand, but no matter how experienced he may be, there always is considerable danger when passing the break. Short rides can be had on waves that already have broken. In fact, this elementary form of surf riding has a considerable following, especially among younger swimmers and persons with small, improvised boards. In catching a half-spent breaker, keep well back on your board and paddle strongly as the water rolls against you. Sometimes you may be carried to the beach.

On the greater swells before the break, tandem riding is gaining popularity. The additional weight makes a wave more difficult to catch, and a steeper slope is preferable. The steersman, who rides behind, first rises to his feet, and then assists his companion to an upright position very close to him. A sturdy rider sometimes is able to hold a passenger on his shoulders.

Those who have years of wave-riding behind them are able to perform sensational feats on the speeding surfboard. It is not unusual to see a man balancing on his head and hands while the craft is in full swing. Others are able to ride backward, turning around by a single quick movement. Two persons riding parallel may change boards in midflight. Such trick riding requires a smooth, clean wave.

Another stunt that catches the eye of the visitor is free-board aquaplaning. As practiced on the hollow board, the rope attached to the power boat is held in the hands of the rider, who maintains his position on the board solely by the friction of his feet on the smooth surface. Sharp turns with the free board are deadly, but in case of a spill you still will have your craft near at hand for support, even though the boat speeds on.

IN "BODY SURFING"—riding waves without a board—the technique varies from that practiced on the surfboards. Although very steep swells may be taken in this manner, most body surfers elect to catch a wave just as it is breaking and then travel with their heads and shoulders just ahead of the "suds." Where the breakers are not strong, you

may find it a help to kick the feet while under way, or to bend one or both legs at the knees.

Some "body surfers" prefer to extend their arms forward, but you will note that under most circumstances the most proficient performers will keep their arms close to their sides. This position allows the chest, which is the body's region of greatest buoyancy, to be as far as possible in advance of the rolling water.

And now, as we rest upon our surfboards, awaiting a green swell which moves silently toward us, let us hail the cradle of the wave rider—Hawaii. May we salute, also, that



Here the swimmer is being paddled ashore

ancient island conquerer, King Kamehameha I. Legend tells us that, even when old in years, he was a skillful wave rider. But surely no man is old who can hitch his surfboard to the untamed waves. To him, and to those other sunny-souled people of the islands, let us be grateful for at least one secret of prolonging youth.

**"YOU'LL
LIKE MY
TOUCH"**

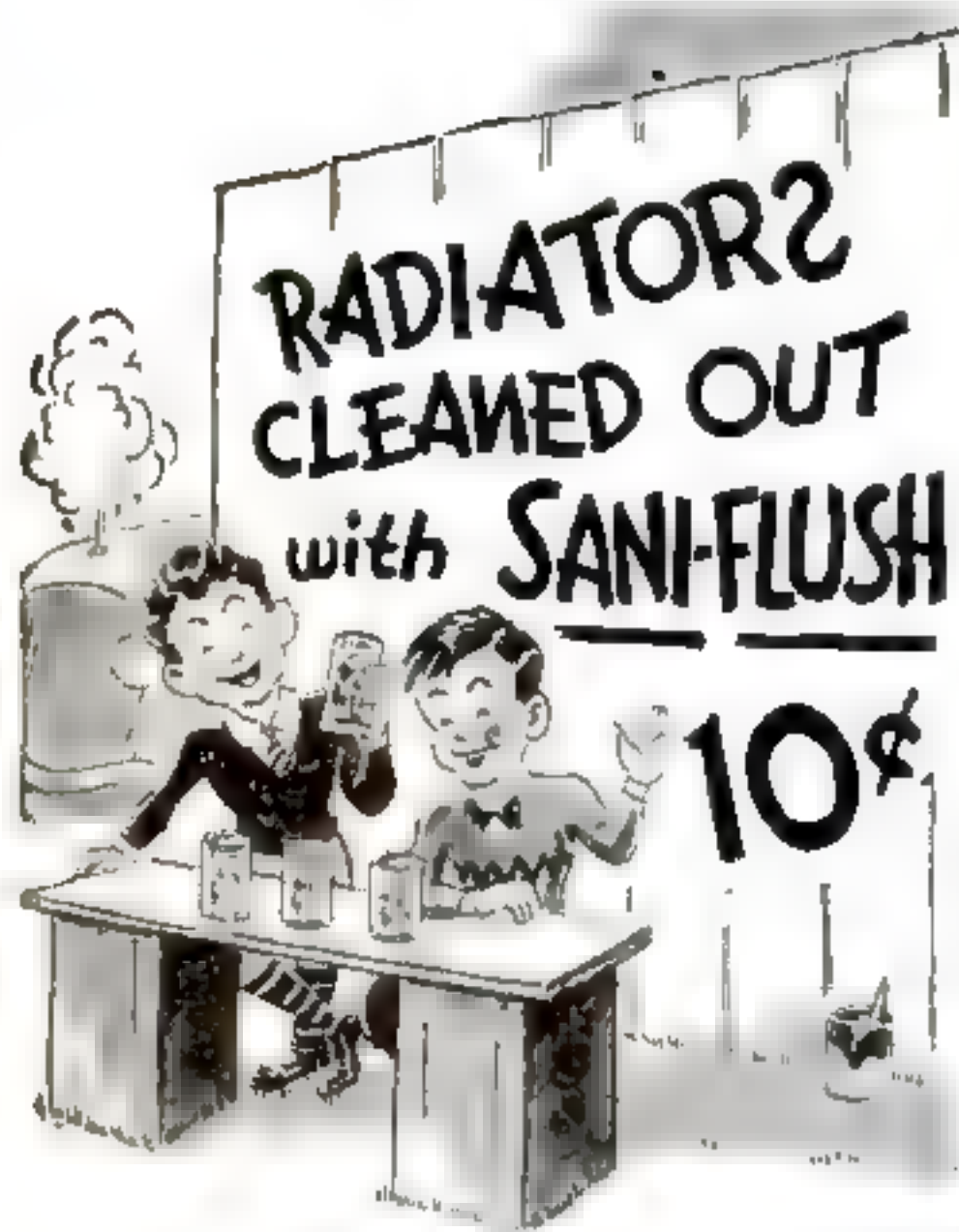


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YOU CAN BE A PLANT WIZARD

(Continued from page 57)

magnifying glass, you usually can see the pollen grains adhering to the surface of the pistil, which indicates that your transfer is completed.

Re-cover the fertilized female parent flower with waxed paper and mark it with a tag to show the parentage of seed that will be in the pod. The pistil withers and the seed pod swells, showing that seeds have formed and the waxed paper can be removed. When the seed pod is ripe, the whole stock can be removed and stored. At planting time, a small stake label bearing the cross parentage is placed on the row or section in which seeds from each single pod are sown. Then wait for the show of bloom.

At blooming time, give a serial number to each seedling worth saving. Save seedlings for two purposes; for their own quality and for breeding use in subsequent generations. Enter the seedling number in a note book, recording its parentage. It is important to know, in the future, the "blood lines" of each seedling.

FOR example, you are crossing a red and a white flower, hoping to develop a salmon tint. You obtain a white seedling that has all the qualities you are after except color. But you know the red strain is in it, for your record shows that. Now, you cross this with a yellow variety. For there is reason to hope that the white-red seedling blended with the yellow will combine the lightness of white, the red tinge of the red parent, and the yellow color to produce a salmon. Your records are your guide; keep them always.

All tools and supplies for your new hobby can be purchased for less than two dollars. They include small hand tweezers, a magnifying glass, a small notebook, some waxed paper, a bundle of durable price tags, and a few cents' worth of garden-stake labels. Manicure scissors are helpful in removing the stamens of some flowers.

The intricate part of plant breeding involves the science of genetics, which gives the groundwork on which a breeder may reasonably predict what he will secure from any cross, provided he knows the blood-line parentage. Genetics is a study in itself, but a practical basis for determining how to cross to get results can be briefly presented.

Each parent has characteristics that are carried to the hybrids. Half a century ago, an Austrian monk named Mendel worked out the law of ratios in which these characteristics will appear in hybrids. His experiments were made with sweet peas. Examination of a sweet pea discloses that both male and female elements are enclosed in a pouch in the lower portion of the flower. Neither insect nor wind can naturally cross-pollinate a pea blossom. They are self-pollinating after an initial hybridization. By "selfing," or inbreeding the blooms beyond the first generation, Mendel learned the way in which the unit characters of parentage will continue to split. Thus came to us "Mendel's law," which is the foundation of scientific breeding.

SIMPLY stated, Mendel's law teaches that, with reference to a given characteristic, one fourth of the hybrids will resemble one parent, one fourth the other parent, and half will be "indeterminate." Seed from this indeterminate group break again in the same ratio when only one unit character, like color, is considered.

In practice, a cross between a white flower and a red one may show one fourth red, three fourths white. This is because the white is conferring what is known as a "dominant" characteristic. It overshadows the other color character, which is "recessive."

Therefore, the plant breeder recognizes that if a white-red cross is made, and one fourth

of the hybrids show red, while three fourths show white, he has the red color "fixed" immediately. But because two thirds of the whites are "indeterminate" hybrids, he must work farther to "fix" that color so it will come true from seed. The "fixing" is merely carrying the dominant color through enough generations to determine which are the "fixed" hybrids of that dominant color.

THIS law applies only when dealing with one unit character, such as color. Practically, the parentage of any flower the amateur deals with is thoroughly mixed already, and the results will show all sorts of intermediate coloring blends, all sorts of other combinations of any single unit character. Furthermore, it is important only when dealing with plants that must be propagated by seeds. It need not worry the hybridizer who works with plants, that can be propagated by cuttings, slips, scions, or bud grafts, for such propagation carries characteristics indefinitely.

Do not overlook the fact that every seedling carries the characteristics of both parents. Some may be submerged, but they are there. By crossing, you may recover them. One plant may have vigor, size, everything but the blossom sought. Another may have the blossom you want. Recross them, and somewhere in the resulting seedlings you will get the combination you want. Look on your crossing as a blending process, from which you select those individuals that show promise of producing what you seek. Approaching from this angle, anyone can make crosses intelligently.

Pollen generally is fertile only on plants of closely related species. A climbing rose can be crossed with a wild rose, or a tea rose with a climber. Natural limits allow a pumpkin to cross with a squash, or either might cross with a cucumber. A tomato has been crossed with a pepper; they belong to the same order of plants.

In this field of crossing between different species in the same family, lies what has been called "plant wizardry." Not even the best plant breeders know how far this sort of cross may be "crowded." It is a shot in the dark. Amateurs will get more certain results by working within a species. But if these "freak" crosses are attempted and are successful, a wholly new sort of plant may result.

Plants that must be propagated from seeds are likely to "break" every which way, and the "fixing" of a new seed-propagated variety may become tedious. A freak cross may be more easily fixed in its characteristics than a cross within varieties. If the amateur plant breeder wishes to get permanent results in the first few generations, he should deal with plants that are propagated asexually—that is, by slips, root stocks, bulbs, or grafts. If you cross irises, and the first generation shows an exceptional seedling, production by division of the root stock will carry to the new plants, all of the characters of that seedling. Gladioluses will do the same in that species. Roses, or similar wooded plants, are similarly propagated by buds, cuttings, or grafts.


THE act of cross-pollination can be accomplished by anybody. Common judgment and alertness in the interpretation of results will go far in bringing success in the production of new varieties. The tools are simple. The laboratory and test plot may be a few square feet in the home yard. One might even produce a new geranium variety in a window box.

Plant breeding can be a fascinating spare-time activity, costing little, perhaps bringing a surprising financial return, if a superior variety or promising novelty is produced. Try it—in your own back yard.

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DOES YOUR CAR HAVE NEW-TYPE BEARINGS?

(Continued from page 110)

there is. With hand-fitted bearings, you never could be certain of anything except that no two bearings would ever be exactly alike. That meant that some cylinders would get more oil thrown on their walls than others, and if a couple of bearings next to each other happened to fit exceptionally tight, the oil supply to the cylinder walls might even fall so low that there'd be excessive wear of the piston rings in that cylinder."

"Then," Walton observed, "if a bearing happens to wear loose, wouldn't so much oil come out of the ends of it that the cylinder directly above would be flooded and foul the spark plugs?"

"YOU forget that all modern motors are fitted with oil-scraper rings designed to keep the oil from getting up past the piston. As long as that ring is working right, there's not much chance of flooding," Gus answered.

"Of course," he went on, "if the ring were a bit worn, and the bearing too, then there'd be trouble. Sometimes that's what's the matter when one cylinder shows oil pumping much more than the others. However, since you have to take off the cap on the connect-
ing-rod bearing to pull the piston out through the top of the cylinder to get at the oil ring in order to replace it, you're sure to catch the trouble, whether it is in one place or both."

"Humph!" Walton grunted, as he reached down from the shelf over his bench a long, thin cardboard box labeled 'Bearing Scrapers—Best Tool Steel.' "Think of all the work I put in learning how to do a bang-up job of scraping a bearing! Now these things won't be any use any more."

"But think of all the time and trouble you'll save," Gus grinned.

"I suppose so," Walton sighed wistfully. "but where's the fun in just sticking in a lot of new parts? Any dumb mechanic can do that!"

NEW MATERIAL TO MAKE AIRPLANES "INVISIBLE"

TRANSLUCENT airplanes, difficult to observe in wartime, are said to be made possible by a new synthetic resin developed by English plastic manufacturers in coöperation with aircraft makers. The new plastic material is strengthened with threads, sheets, or fibers of cotton, which may be arranged to run in all directions, thus giving more uniform strength characteristics than wood. In comparison with metal, the new material is said to be less subject to vibration and noise. It can be made in any color or degree of translucency. One present difficulty that prevents the plastic's immediate adoption for airplane construction is the lack of a method of gluing or welding the joints, but it is believed that this problem can be solved.

WINES ARE GRADED BY MEASURING COLOR

MEASURING its color is the latest method of detecting dilution or adulteration in wine, a French scientist reports. Like most other colored substances, the hues of red and yellow wines have individual characteristics, which can be determined by instruments called spectrophotometers. Wines from the same district usually produce similar color curves, but even the differences between one vineyard and another can usually be detected. Vintages of different years also differ slightly in color, corresponding to the differences in flavor recognized by connoisseurs. The new method is expected to check dishonest wine dealers.

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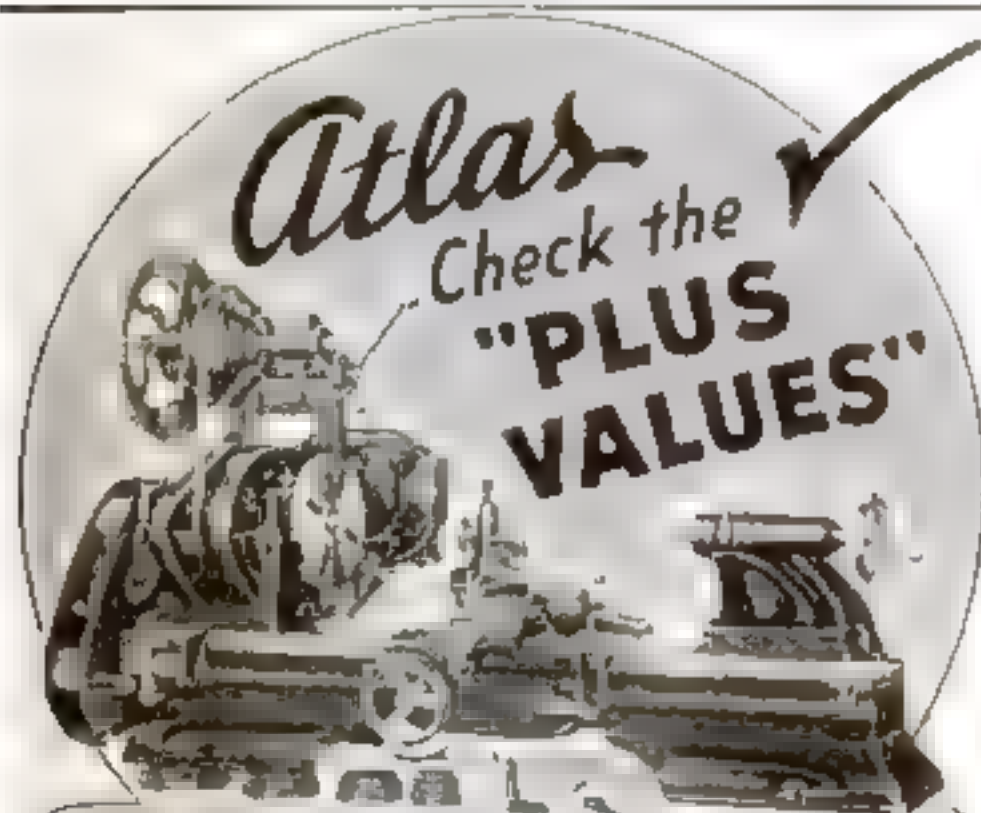
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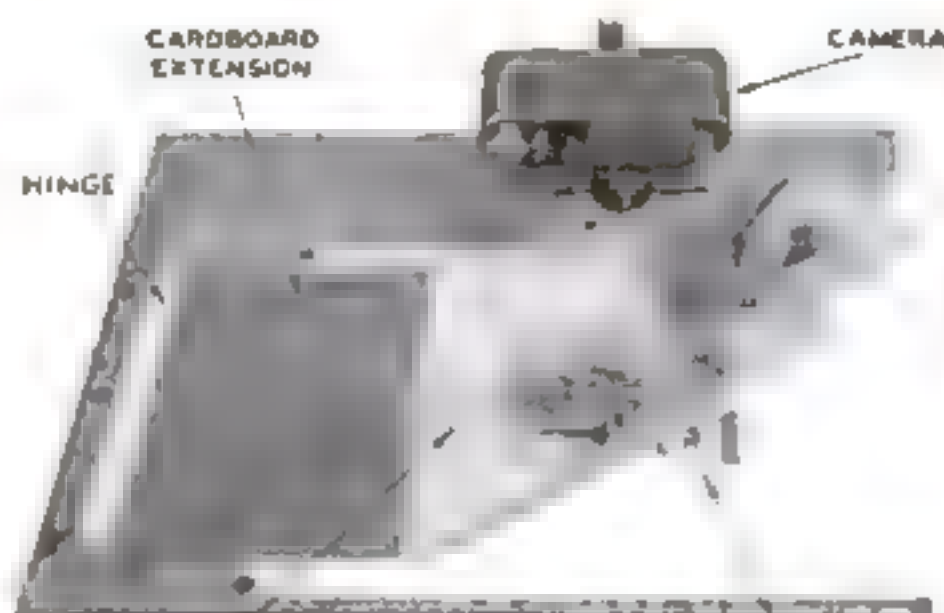
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RULED CELLULOID SHEET FOR PHOTO COPYING

IN USING a miniature camera without a ground glass for copying purposes, the work can be centralized by means of a previously adjusted celluloid sheet, cross ruled as shown with lines $\frac{1}{2}$ in. apart. The celluloid is fastened to one edge of a sheet of cardboard with adhesive tape, and the other edge of the cardboard is hinged so that the guide may be lifted out of the way.

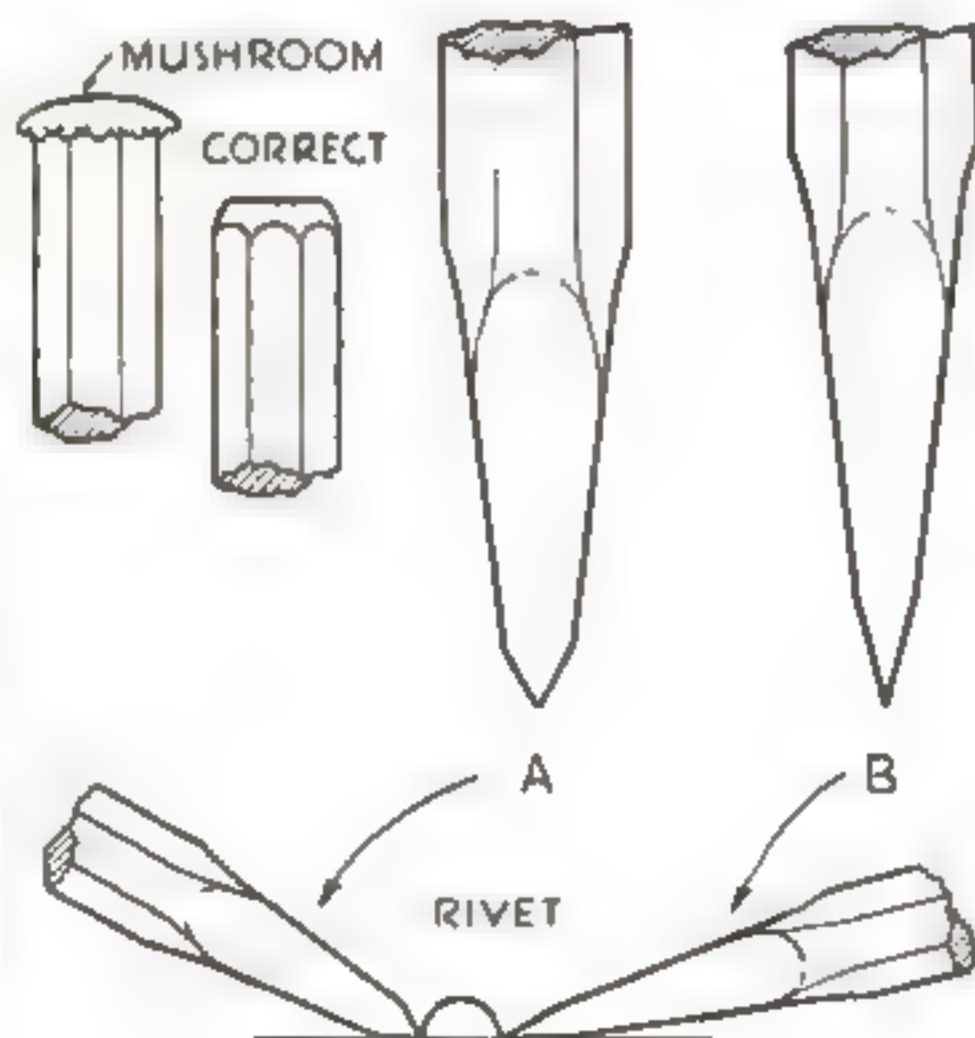
The camera must, of course, be square with the easel, and the guide itself is adjusted by means of a plumb bob. With the aid of the



The copy is centralized by slipping it under a previously adjusted celluloid guide sheet

table provided with the auxiliary lens used for copying, a set of photos should be made at the indicated distances; and these pictures show how much of the guide is included so that, once the size of the copy is known, it may be quickly centralized under the lens. The camera stand and guide must, of course, be mounted on the same easel.

CHOOSING COLD CHISELS TO SUIT YOUR WORK



COLD chisels with various types of noses are sold, and every home workshop should have at least two—a regular flat-nose chisel like A for stripping and cutting down, and one like B for knocking off the rusted heads of bolts and rivets. I can work best with a stripping chisel if its cutting edge forms a 60-deg. angle, and with a "rivet buster" if its nose is at 30 deg. To determine roughly the angle of a chisel point, bend a piece of stiff wire to fit, then lay the wire on a piece of paper and trace the angle with a pencil. By laying a protractor on this pencil line, it is easy to read the angle. You can also use the wire as a grinding template.

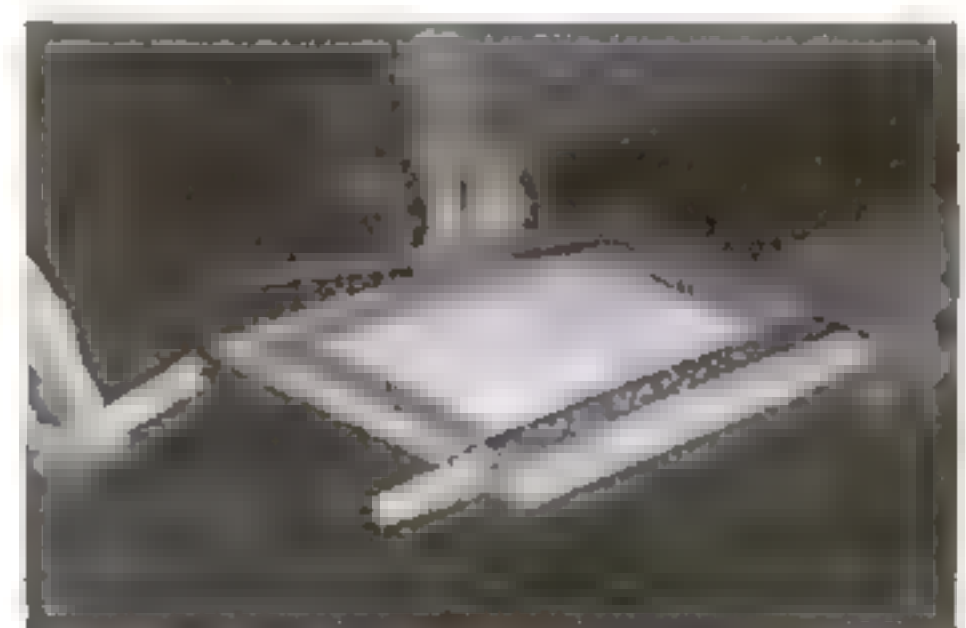
A good mechanic never permits his tools to "grow mushroom heads." A chisel with a mushroom head is dangerous because a chip is likely to fly off.—W. PHAIR.



HINGED EASEL IMPROVES HORIZONTAL ENLARGER

HINGING the easel of a horizontal enlarger to its base simplifies the task of accurately masking and manipulating projection paper. After the image has been focused on the upright easel in the usual manner, the board is lowered, and the process of laying and masking the paper is the same as with a vertical machine.

One method of holding the paper in place is to nail two wooden strips across the bottom



Two flexible wooden strips hold the mask and paper in place. The easel is then raised to the position shown at the top of the page

of the easel, the outer strip overlapping the other about $\frac{1}{4}$ in. Into the slot thus formed are inserted two flexible wooden strips, which are then laid over the side borders of the mask and clamped as shown to the top of the easel.

A bed brace from an old folding camera holds the easel upright, but angle irons screwed to the base and a spring or back support to press the easel firmly against them are as effective.—ELMER A. TURNER.

FILTER ADAPTS EXPOSURE METER FOR VERY BRIGHT SCENES

THE range of a photo-electric exposure meter for photographic work may be increased when it is necessary to measure the illumination of a very brilliantly lighted scene by covering the entire cell opening with an inexpensive gelatin filter of known density. This is a better and more reliable method than merely blocking off part of the opening with a cover of aluminum or some other light sheet metal.

With the latest type of exposure meters, I have found that a so-called "K2" filter works very well; in this case, the meter readings are simply doubled to get the correct exposure. The filter may be hinged to the blanked-off face of the meter next to the cell opening in such a way as to swing over the cell opening when needed.—A. J. GILARDI.



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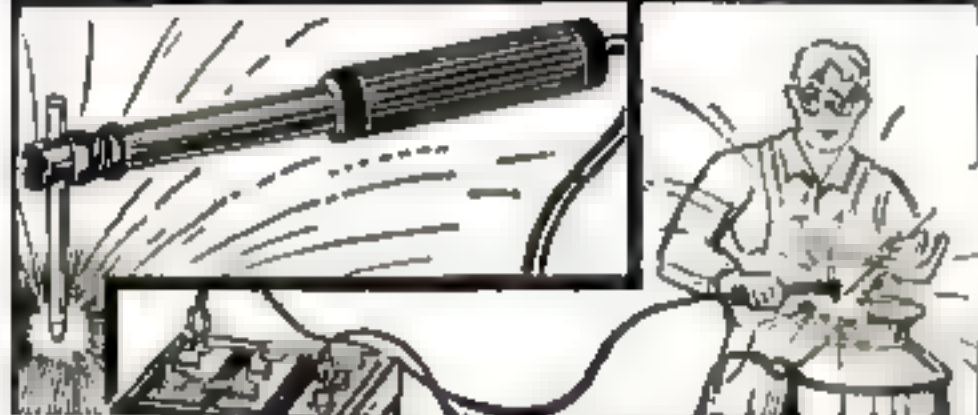
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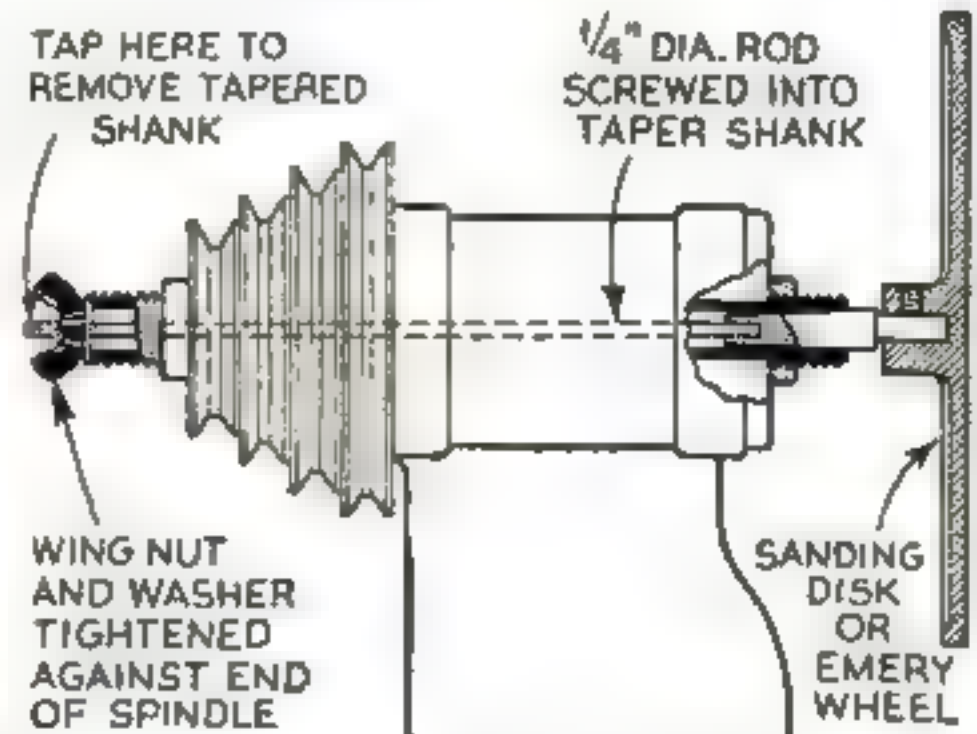
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HOLDING TAPERED SHANK IN LATHE SPINDLE



TO PREVENT a sanding drum or disk or a grinding wheel from loosening when mounted on a taper shank in one of the newer types of small workshop lathes, the method illustrated may be used. The end of the taper shank is drilled and tapped for a 1/4-in. diameter rod, threaded at both ends and long enough to extend through and beyond the rear of the spindle. A wing nut is screwed on this end tightly by hand against a washer bearing on the outer end of the spindle.

With a grinding-wheel arbor, the same result may be obtained by running the tail center against the projecting end of the shank, but this expedient will not serve with sanders or faceplates.—**JOHN P. ADAMS.**

SMALL CONCRETE FORMS MADE FROM CARDBOARD AND PAPER

IN CEMENTING a metal downspout at the point it enters a larger tile pipe placed in the ground, it is often necessary to improvise a form to retain the concrete until it has set. Cardboard or even a number of thicknesses of newspaper may be used to form a cylinder for this purpose. To prevent the concrete from falling into the larger drain tile and to keep the downspout centered in the opening, a two-piece collar may be sawed from wood, the inside to fit the downspout, and the outside to set tightly inside the tile.—**J. H.**

HOW TO GLUE UP WOOD FOR INLAID TURNINGS

(Continued from page 103)



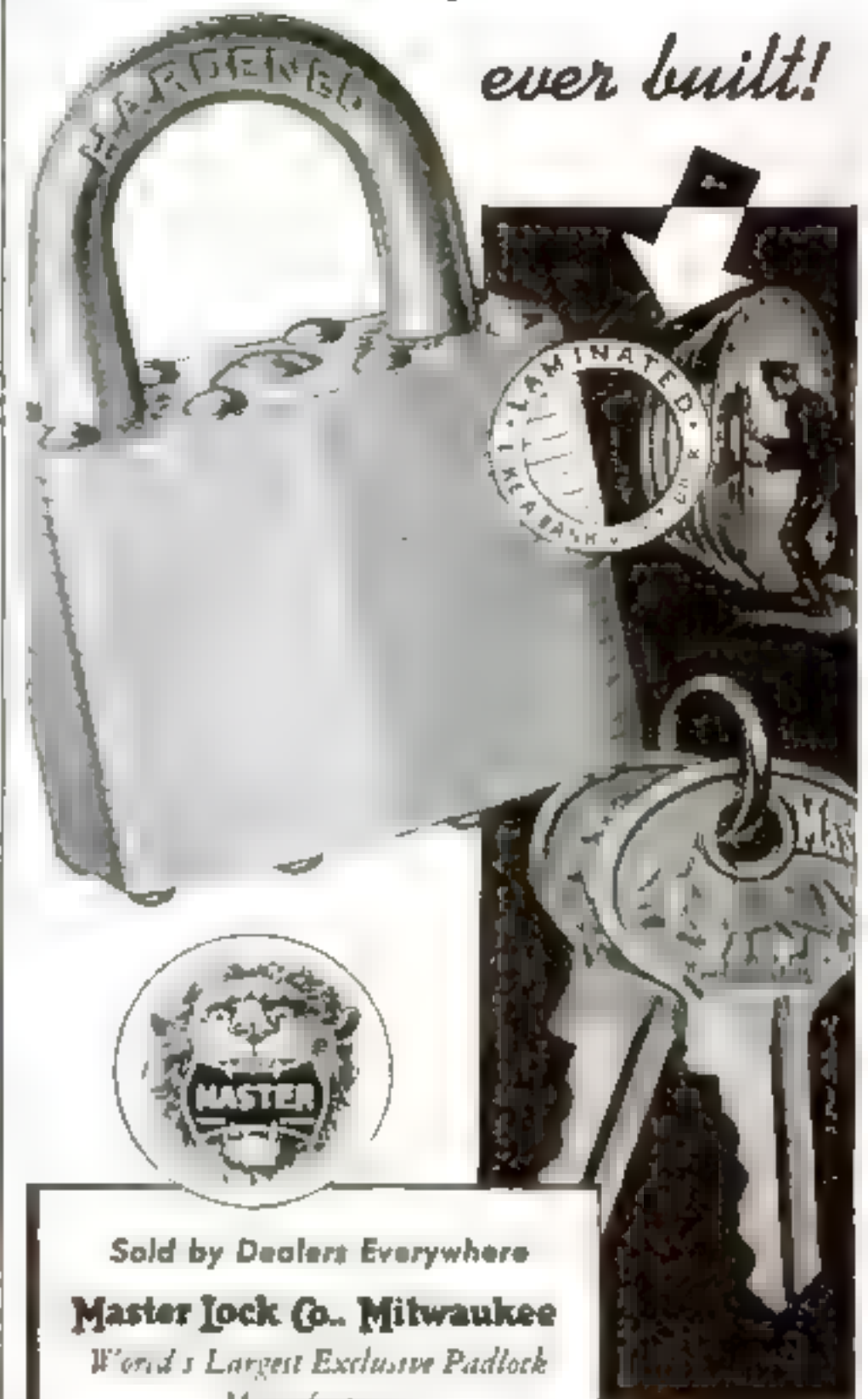
If neither the saw nor the table will tilt, the staves must be cut in a form like this

lowed to dry thoroughly, the cylinders are then sawed up into rings of thicknesses that will give the desired effect in the finished product. This can be accomplished by revolving the cylinder in a form fitted to the trim saw, or the cylinder may be taken to a mill and trimmed off on a large band saw.

The rings are then glued together so that the woods are arranged in good color contrast. Pressure should be applied by any convenient method during the gluing process. Moisture absorbed by the wood from the glue should be thoroughly but slowly dried out before the turning is done.—**MELVIN J. PHILLIPS.**

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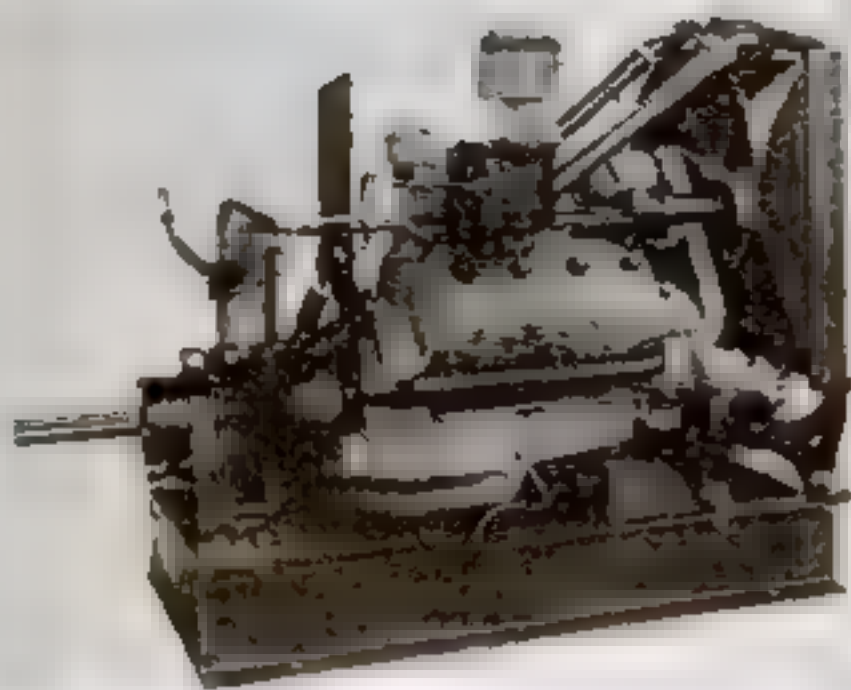
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(Continued from page 89)

mast cap, and the royal stay to eyes of the fore topgallant rigging.

Lower yards. Set with trusses, and fasten chain slings to hold the yards horizontal. Topping lift, of medium thick light brown or natural cord, starts at heel of a 5/32-in. block strapped to the cap; goes through a similar block at yardarm, through upper block, and down through lubber holes, through the fife-rail post, and is there belayed.

Topsail yards. Fasten the parrel. Lifts start at eye on yardarm, go over crossrees and down to other yardarm. A seizing at masthead will keep the yard even. For hal-yard tie, fasten a thin chain to the midship eye; reeve through hole in masthead, and seize a 1/4-in. block to the end, abaft. The halyard, of medium black cord, starts at the eye in the channel (port side at the fore), goes through the block, and has a double block seized in the other end. The fall is rove through this and a single block in the opposite channel. It finally comes down to a single block strapped to a bolt in the waterways; then up to a belaying pin.

Topgallant yards are similar. The ties can be cord, coming down to one side only (port at the fore) with a single block at the end, and a double block on the waterways. Royal halyards are again the same, but each, of course, made with lighter cord; they come down with two single blocks (starboard side at the fore).

Braces. Because of the way they cross (the "cat's cradle"), it is easier to start at the top. For the fore royal and topgallant braces, seize small double blocks on each side to the eye of the main topmast stay; also another abaft at the same level under the topmast shrouds. Reeve the single royal braces through the outer holes and down abaft to the fife rail. Start the topgallant brace with a hitch in its bight on the stay, just below the blocks; through the yardarm blocks, and follow the royal braces. Fore topsail yard braces start with eyes seized to the eye of the mainstay; go through blocks at yardarms; through blocks on main rail, and there are belayed in the usual way.

Fore braces start at bolts in bulwarks; reeve through yardarm blocks; through blocks strapped to main rail, and are belayed. Main royal braces go through single blocks seized to fore topmast cap and go down abaft through lubber hole to fife rail. Topgallant braces start at heels of blocks strapped to topmast backstays; are then passed through the yardarm blocks; through the first-named block, and to fife rail. Topsail-yard braces start at heels of blocks hooked or strapped to eyebolt in main lowermast head; go through the yardarm blocks; through the mast blocks; then down, where they belay to pin in main rail. Main braces start at blocks hooked to eyes in truss band; through yardarm blocks; then back and down to the main rail.

Spanker. Set boom with thin cord around mast; this goes through holes in jaws and has a knot in each end. Seize bight of boom topping lift to boom at shoulder; reeve each end through blocks strapped under trestle-trees, and finish with two single blocks. The sheet or sheets may be rove off in various ways. Mine has a 1/4-in. double block sliding on the boom traveler with single blocks, either side, hooked to waterways. The bight fastens to a ring under the double block; reeves in endless fashion, and has an end belayed to pins in the main rail on either side.

On the retaining cord of gaff I threaded five little white balls so that it would go up and down the mast easily. As no sail is set, the gaff really should be lowered to the boom, but looks much better if hoisted as in the

photos. The throat halyard is a double block hooked to a bolt under the top and to another on the gaff close to the mast. A thin downhaul is fastened from a bolt under the gaff to the fife rail. Start the peak halyard at the gaff end; reeve through a double block at the cap; through a single block rather more than halfway out on the gaff; through the double block, and down to the main rail. The vangs are single cords from the gaff, finishing in single blocks, with falls belayed to the main rail.

Studding sails. If desired, studding-sail booms may be fitted to lower, topmast, and topgallant yards, each half the length of their respective yards and about one third as thick.

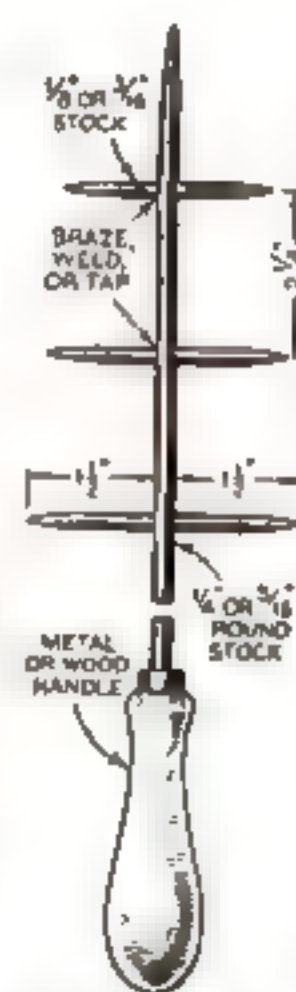
Anchors. Two anchors about 2 in. long are suitable, with wooden stocks the same length. To the ring of one, fasten a chain of about eight or ten links to the inch; bring it up through the hawse hole; around the windlass, and down the chain pipe. If the hull has been left partly unplanked, bring the end up the other chain pipe and to the other anchor; if not, use two pieces of chain and wedge their ends in the chain pipes. Fasten a piece of very small chain to the after bolt on the cathead, take it through the anchor ring and up through the hole in the cathead. Hold it with a pin point through the last link. The crown and fluke are lashed to a bolt in the waterway or timberhead.

Base. Any style may be used. Mine is a piece of wood 3/4 by 6 by 18 in., to which I doweled two 1/4-in. square posts, set 12 in. apart, one 3/8 in. higher than the other. In their ends are grooves just large enough to take the keel, and through them and the keel are driven thin nails to hold the model down. Dowel-stick shores are pushed up from beneath through slanting holes near the edge of the base to the bilges of the model in order to hold the model exactly upright. I set the model permanently on this after I had fixed the deadeye straps.

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TIN TUBE IS AN AID IN SEWING WITH A HARNESS NEEDLE

SEWING with harness makers' needles is awkward for the average man, especially if one side of the seam is hidden. I speed up the work by making a small tube or cannula of tin slightly smaller than the awl. After pushing the awl through, I withdraw it and insert the tube. It is now very easy to enter the needle in the end of the tube and draw both through the goods together.—M. L. Toop.

This One



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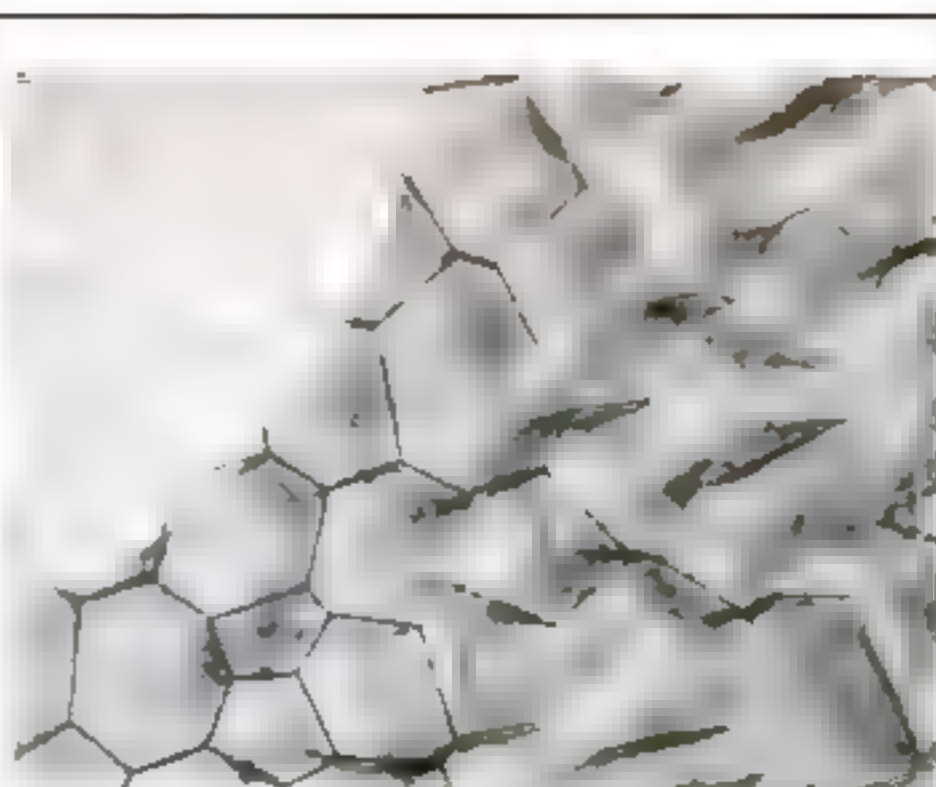
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A pattern being developed by tracing a photomicrograph that shows membranous partitions between limestone blocks in a sea shell

ART DESIGNING WITH YOUR MICROSCOPE

(Continued from page 63)

tomicrographs of such pattern arrangements can be used in decoration. Pollen grains, insect eggs, and other small objects whose shapes make them beautiful can be used in "spotty" decorative schemes such as those employed for wall paper, dress goods, or book covers.

Speaking of book covers, here is an idea that you might find useful for such things as notebooks, scrapbooks, and diaries: You are going to make, for instance, a botany notebook, and want an appropriate cover. What could be more logical than a photomicrograph of some botanical subject? Perhaps the cross section of a flower stem or a leafy bud, or the membrane from a bean cotyledon stained with Loeffler's methylene blue, would be suitable.

Whatever the picture you choose, print it on a dull-surfaced paper. There is available a type of photographic paper intended for use in printing maps, pages for salesmen's catalogs, and so forth. It is a thin paper with a mat surface coating that will not break easily when bent. This is ideal for cover work. After the print has been washed and dried, glue it securely to the cover, which probably will be a sheet of stiff cardboard. When the glue has dried, give the surface of the photograph a coat or two of clear varnish or lacquer, to protect it. Any lettering should be added before the varnish is applied. Likewise, if you desire to color the photographic design with water or oil pigments, do so before the final varnishing.

Instead of covering the entire surface of the backing material with a photograph or group of them, you can apply a single print, in the form of a circle, rectangle, or other shape, and varnish it for protection. Use a good grade of glue for such work. One of the most permanent is stainless casein glue, which is waterproof after it dries. Rubber cement can be used for temporary work, but is not recommended when the job is expected to last several years.

THE present popularity of photographic murals for decoration suggests the idea that photomicrographs might be employed in some instances. Thus, the walls of a biological laboratory could be papered or paneled with photomicrographs of biological subjects, which, besides being decorative, would be instructive as well. Such photomurals are simply greatly enlarged photographs hung like wall paper. They can be protected by a transparent varnish or lacquer coat when necessary. Frequently the murals are arranged in panels, rather than as a cover for the entire wall.

And so, in these and a thousand other ways, photomicrographs and drawings of microscopic objects can serve the world of art as well as that of science. The applications of such designs are limited (Continued on page 118)

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ART DESIGNING WITH YOUR MICROSCOPE

(Continued from page 117)

only by the imagination and ingenuity of the people using them.

In general, microscopic objects that are, in themselves, interesting in form make the best designs. The plant world offers some of the most promising and most easily prepared material. Simply by slicing thin sections from a leaf, stem, leaf bud, or flower bud, you can obtain great beauty of form. Although sections cut with a precision microtome are the best, you can do very well with a razor blade and a wooden chopping block, or a simple hand microtome. Soft stems frequently are easier to cut if braced by inserting them between two grooved pieces of potato, carrot, cork, or other firm but easily sliced material.

FOR modernistic patterns, the crystal world offers many suggestions. Dissolve some Epsom salts, copper sulphate, borax, or almost any other crystalline substance in warm water, place a drop of it in the middle of a clean slide, set it aside to dry, and you have a beautiful work of art. If you are seeking suggestions for color harmony and contrast, examine the crystalline pattern by polarized light, as described in a recent installment of this series (P.S.M., Dec. '36, p. 52). The only difficulty you will have is in reproducing the marvelous colors with ordinary pigments.

Permanent capture of such colors can be made only with the aid of color photography. Not long ago there was introduced to the photographic world a new film that reproduces color with amazing faithfulness. It is excellent for making natural-color records of colored microscopic objects. The single colored transparency obtainable with each exposure can be used for making a duplicate negative from which any number of black-and-white copies can be printed. Thus the original color picture can preserve also the form, and make it available for photographic reproduction in unlimited quantity.

In the sands of the sea you can find objects whose beauty suggests their use as artists' models. Seagoing diatoms are, of course, among the most beautiful. Near the surface of the sea in warm climates you will find radiolarians, whose basketlike skeletons, seemingly spun from the finest crystal, ought to provide inspiration for designers of glassware and jewelry. Among the grains of sand found in sponges you may discover tiny foraminifer shells—microscopic sea shells often of great beauty.

Some of the microscopic shells exhibit a curve that is, according to art authorities, among the most beautiful forms in nature. It is known by various names, such as the "curve of growth" and the "Greek rhythmic curve." The boundary line between the spiral layers of a chambered nautilus, or even of a common snail shell, is in the form of this magic curve. The animal inhabiting the shell produces such a curve when it increases the size of the shell without changing its shape. The rhythmic curve is employed widely in design and composition. You will see it in the decorations on furniture, fabrics, and an almost endless number of other articles; and you can detect it in the composition of paintings and photographs.

ALMOST every object upon which you turn your microscope's inquiring eye might be used as a pattern for a design—the scales on insect wings, the mosaic of lenses in the eye of the bee or fly, vase-shaped spore pods of fungi, the snail's tongue, which you can obtain by boiling the entire snail in lye solution—these and a thousand and one other things can serve as your starting point for something new and striking in the field of decorative design.

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EASY CHEMICAL TESTS OF HOUSEHOLD PRODUCTS

(Continued from page 65)

and cigarette paper in your own laboratory.

Pure nicotine is a colorless liquid. What a chemist means when he speaks of the "nicotine" in tobacco, however, is nicotine citrate or nicotine malate. These are nicotine salts of citric and malic acids, the acids familiar to us in lemon juice and in apple juice.

Calling a salt like nicotine citrate by the plain name of "nicotine" should not confuse you. When we speak of the potassium that plants need in the soil for their proper growth, for example, of course we mean some salt of the metal, such as potassium carbonate or potassium silicate, and not the metal itself. If the ground actually did contain metallic potassium, which reacts with water to produce fire, what a picturesque and terrifying place the earth would be each time it rained!

TO TEST for the nicotine in tobacco, break up several cigarettes or half a cigar in a tall jar, beaker, or glass vase, and add several fluid ounces of a solution of sodium hydroxide (lye water) to the tobacco. Now hold a blob of absorbent cotton, wet with strong hydrochloric acid, just above the contents of the vessel. You will see a dense white cloud of "smoke" form around the cotton.

The chemistry of the process is simple. The alkali or lye water releases the nicotine from its combination with citric or malic acid and forms free nicotine. As this liquid is highly volatile, some of it is liberated in the vessel as a vapor. Now, when the vapor of hydrochloric acid is introduced in the vessel by the acid-soaked cotton, the nicotine vapor reacts with it to form nicotine hydrochloride. This is the white "smoke" that is formed. You may recall that the vapors of hydrochloric acid and of ammonia also react to form white smoke, consisting of ammonium chloride, but you can readily show that ammonia is not involved in the present instance. A wet strip of red litmus paper, held in the vessel after the caustic is added, does not turn blue, showing that no ammonia vapor is released by the action of the alkali.

Large tobacco companies employ ingenious machines to smoke cigarettes mechanically and analyze the chemical products in the smoke. If you wish to investigate for yourself what happens when tobacco burns, you can easily rig up one of these "robot smokers" in simplified form.

Fit the tip of a cigarette into one end of a glass tube, which serves as a holder. Connect the other end of the tube to a glass L tube, using rubber tubing provided with a pinch clamp or a spring-type clothespin. Insert the L tube in one hole of a two-hole stopper fitted to a gallon jug of water, which acts as a suction pump. The other hole in the stopper carries a longer glass tube that dips into the water, and at the top of this tube a long section of rubber tubing is attached. The siphon is started by sucking on this rubber tubing. When you open and close the pinch clamp or spring clothespin, the cigarette in the holder can be smoked in puffs, realistically imitating the customary manner of smoking.

PLACE a wet strip of blue litmus paper in the glass tube that serves as the cigarette holder, and set the robot smoker working—or, if you are a user of tobacco, simply place the glass tube to your lips, without the attachments, and draw the smoke through it. Presently the litmus paper will turn red. The change is produced by formic acid and other acids contained in the smoke.

Quite different, however, is the smoke coming from the other end of the cigarette—the wisp that curls upward from the glowing tip, and that is not (Continued on page 120)



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| <input type="checkbox"/> Structural Engineer | <input type="checkbox"/> Building Foreman |
| <input type="checkbox"/> Electrical Engineer | <input type="checkbox"/> Diesel Engine |
| <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> Aviation Engineer |
| <input type="checkbox"/> Telephone Work | <input type="checkbox"/> Automobile Work |
| <input type="checkbox"/> Management of Inventors | <input type="checkbox"/> Plumbing |
| <input type="checkbox"/> Mechanical Engineer | <input type="checkbox"/> Steam Fitting |
| <input type="checkbox"/> Mechanical Draftsman | <input type="checkbox"/> Heating |
| <input type="checkbox"/> Patternmaker | <input type="checkbox"/> Ventilation |
| <input type="checkbox"/> Foundry Practice | <input type="checkbox"/> Air Conditioning |
| <input type="checkbox"/> Reading Shop Blueprints | <input type="checkbox"/> Refrigeration |
| <input type="checkbox"/> Heat Treatment of Metals | <input type="checkbox"/> Pharmacy |
| <input type="checkbox"/> Sheet Metal Worker | <input type="checkbox"/> R. R. Locomotive |
| <input type="checkbox"/> Welding, Electric and Gas | <input type="checkbox"/> R. R. Section Foreman |
| <input type="checkbox"/> Civil Engineer | <input type="checkbox"/> R. R. Signaller |
| <input type="checkbox"/> Highway Engineer | <input type="checkbox"/> Air Brakes |
| <input type="checkbox"/> Surveying and Mapping | <input type="checkbox"/> Coal Mining |

BUSINESS TRAINING COURSES

- | | |
|-------------------------------------------------------|------------------------------------------------------|
| <input type="checkbox"/> Business Management | <input type="checkbox"/> Business Correspondence |
| <input type="checkbox"/> Industrial Management | <input type="checkbox"/> Lettering Show Cards |
| <input type="checkbox"/> Traffic Management | <input type="checkbox"/> Stenography and Typing |
| <input type="checkbox"/> Cost Accountant | <input type="checkbox"/> Civil Service |
| <input type="checkbox"/> C. P. Accountancy | <input type="checkbox"/> Mail Carrier |
| <input type="checkbox"/> Bookkeeping | <input type="checkbox"/> Railway Mail Clerk |
| <input type="checkbox"/> Secretarial Work | <input type="checkbox"/> Grade School Subjects |
| <input type="checkbox"/> Salesmanship | <input type="checkbox"/> High School Subjects |
| <input type="checkbox"/> Service Station Salesmanship | <input type="checkbox"/> College Preparatory |
| <input type="checkbox"/> Advertising | <input type="checkbox"/> First Year College Subjects |

DOMESTIC SCIENCE COURSES

- | | |
|---------------------------------------------------|-------------------------------------------------|
| <input type="checkbox"/> Professional Dressmaking | <input type="checkbox"/> Millinery |
| <input type="checkbox"/> and Designing | <input type="checkbox"/> Foods and Cookery |
| <input type="checkbox"/> Home Dressmaking | <input type="checkbox"/> Tea Room and Cafeteria |
| <input type="checkbox"/> Advanced Dressmaking | <input type="checkbox"/> Management, Catering |

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Address.....

City.....State.....

Present Position.....

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How long will a Schick last?

#15



AC and DC

A radio officer on a ship continuously traveling between cold climates and the tropics writes that he has shaved every day for three years with a Schick and never spent a penny for repairs or replacements. *And his shaver does not show the slightest sign of wear.*

Frankly we don't know how long a Schick will shave. Some of the first Schick Shavers, made five years ago, are still running perfectly and shaving as quickly and closely as they did in the beginning.

Many customers write and tell us of from one to four years' perfect shaving service from their Schick Shavers. One man has reported 2000 shaves from his Schick—another 1500.

How Could Shaving Cost Less?

Even three years of once-a-day shaving with the Schick brings the cost of shaving down to less than a penny-and-a-half a shave—and the shaver is still good.

Contrast this with the cost of buying blades, sharpeners, soap, cream, brush and lotion.

Economy is a Minor Factor

The best reason for owning a Schick is that it brings more pleasure into a man's life than he can get from any other personal possession.

He cannot cut, scrape nor hurt himself. He can shave twice a day, shave in the dark, read while he shaves, shave with his coat on or while wearing glasses if he desires.

With the Schick, the scar tissue formed by blade-shaving, vanishes and a new, more youthful and flexible skin replaces the dead, scaly skin.

Believe The Men Who Use Schicks

Schick users will tell you they would not sell their shavers for \$100 if they could not buy another.

More than a million are in daily use on tough beards, tender skins, on faces that used to have ingrowing hairs, on cheeks that never knew a comfortable moment under the old method of shaving.

See a Dealer Today

Any of our dealers will show you a Schick Shaver and explain how you should use it. Do not postpone shaving comfort another day.

SCHICK DRY SHAVER, INC., STAMFORD, CONN. Western Distributor: Edises, Inc., San Francisco.
In Canada, Henry Birks & Sons, Ltd., and other leading stores throughout Canada.

SCHICK SHAVES

EASY CHEMICAL TESTS OF HOUSEHOLD PRODUCTS

(Continued from page 119)

drawn into the mouth in smoking. Hold a wet strip of red litmus paper in this smoke, and the test paper will turn blue, showing the presence of an alkali—in this case, ammonia. If your eyes have ever smarted in a room that is cloudy with tobacco smoke, now you know why; the ammonia vapor released by the burning tobacco is largely responsible.

A bit of chemical testing also will give you an insight into the chemistry of cigarette paper. Often this material is "loaded," or impregnated with some filler, to make it more opaque and to control the rate of burning. This should in no sense be considered an adulterant, since it is not used to cheapen the product, but is incorporated with the paper pulp to serve a useful purpose. Calcium carbonate, the same material of which chalk and marble are composed, is the filler generally employed.

TO TEST for this material, reduce several sheets of cigarette paper to ash. The best way to do this is to heat the paper in a porcelain crucible or evaporating dish, using a Bunsen burner, until the carbon has been entirely burned out. This will leave a white ash behind. During the heating, the calcium carbonate will have been converted into calcium oxide, or quicklime. Add several drops of water to the ash, and calcium hydroxide, or slaked lime, will form and dissolve. Now, when you add a drop or two of phenolphthalein to the liquid, it will turn violet-red, showing the presence of an alkali. The alkali responsible for the appearance of this color comes from the calcium carbonate originally present in the cigarette paper.

Instead of adding phenolphthalein, you can dip a platinum wire in the solution you have prepared, and then hold the wire in the blue Bunsen flame. The presence of calcium tinges the flame with a carmine-red color. A little of the liquid may also be filtered and treated with a solution of ammonium oxalate. A white precipitate forms. When ammonium oxalate solution is added to a liquid under test, such a precipitate strongly indicates that the liquid contains calcium.

MAN-MADE METEORITE HAS STARLIKE CRYSTALS

PRODUCED in the laboratory of the Carnegie Institute of Technology, the first man-made meteorite offers new clues to the origin of the fragments that fall to the earth from outer space. The nickel-iron alloy of which real meteorites are composed can readily be produced artificially, but heretofore, the synthetic meteorites have differed from the real thing in one important particular, the arrangement of crystals. The crystals in the celestial alloy are arranged in such a form as to indicate that at one time the body consisted of one large crystal, even in the biggest meteorites, which weigh as much as eighty tons. Largely by accident, it was discovered that the proportions of nickel and iron do not form a part in the formation of this crystal pattern, but that the arrangement of crystals depends upon a high initial temperature, and a very slow rate of cooling. The inference is that each meteorite was originally a piece torn from a hot star, and cooled slowly by remaining in the hot atmosphere of the star for some time before reaching the cold outer space. Oddly enough, the hickory-nut-size, artificial meteorite expanded on cooling, instead of contracting, as metals generally do. This is because the celestial crystal pattern needs more room than the normal arrangement of the crystals. From this it is reasoned that a meteorite is smaller when it leaves its parent star than when it reaches the earth.

SUPER-PRESSURE STEAM

secret of liner's 200,000 H. P.

81,235 TONS of modern superliner—
the Cunard White Star liner "Queen Mary."



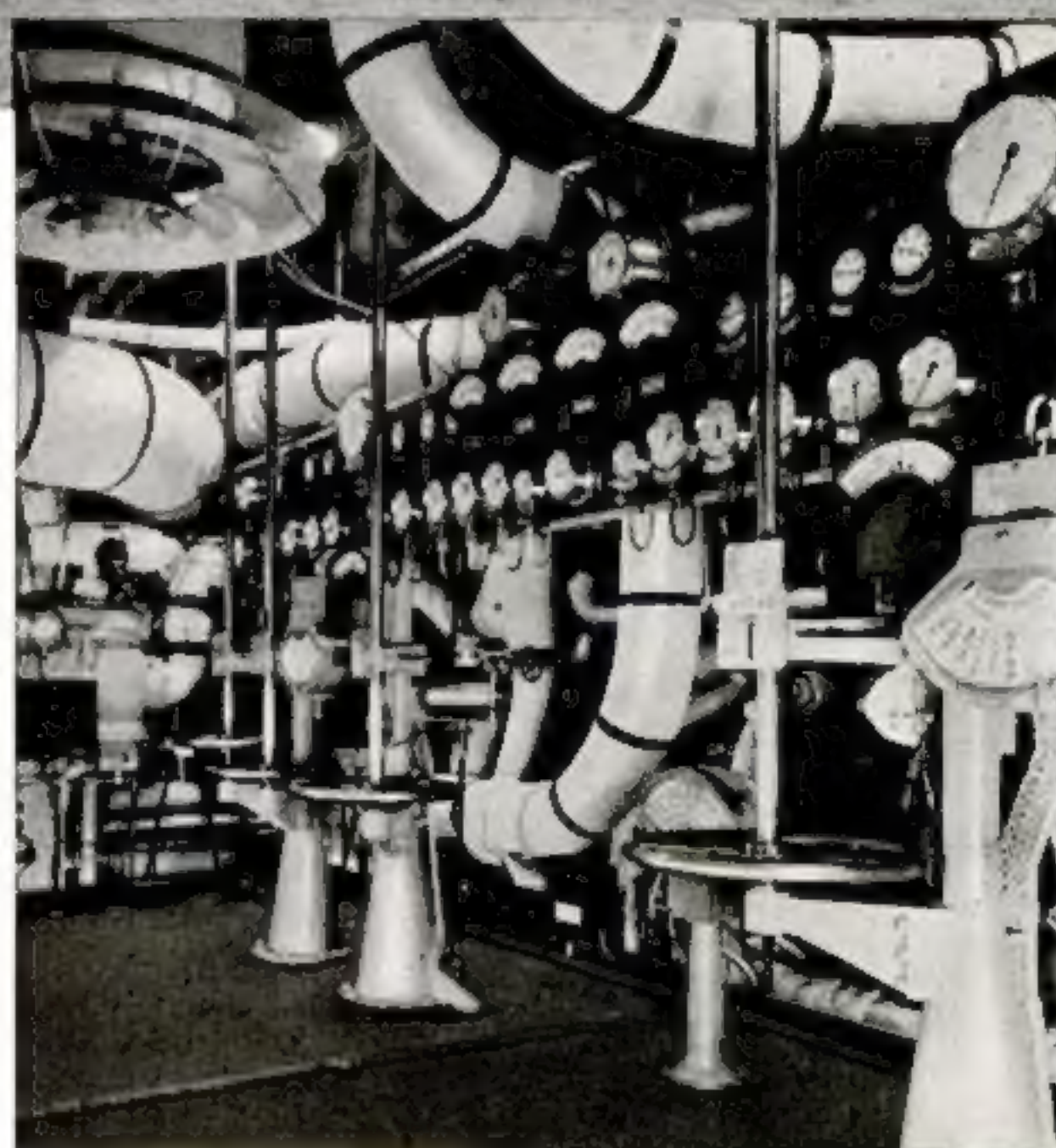
"Queen Mary" engines illustrate HIGH COMPRESSION feature of modern autos

MARINE ENGINEERS now get more power out of every gallon of fuel oil by super-heating steam—increasing operating pressures. Automobile engineers give you more from every gallon of gasoline by increasing compression ratios—building modern cars with high-compression engines.

Cars in every price class today offer the extra power, extra mileage, extra responsiveness that high compression gives. But to get all these advantages you must set the spark for maximum performance and use high-compression fuel!

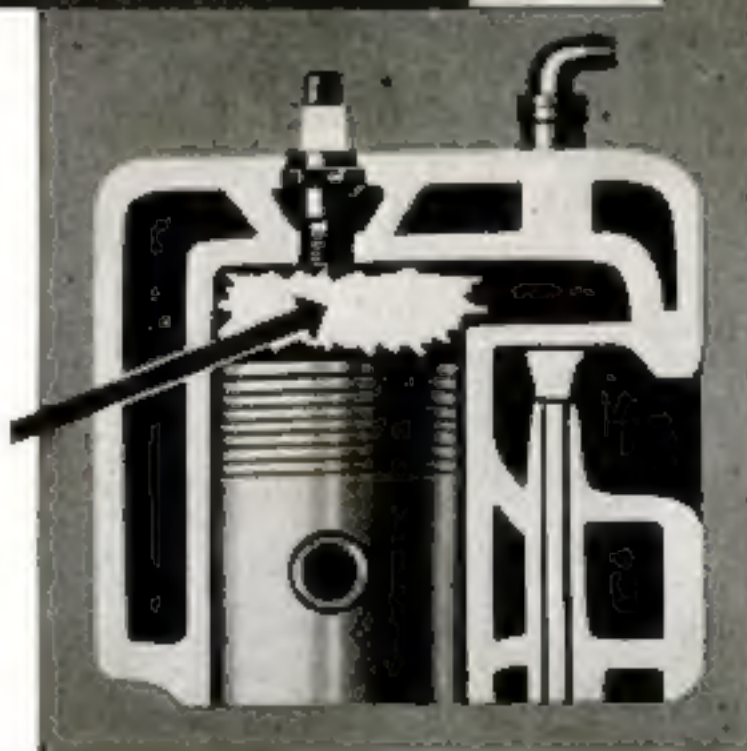
Where do you get high-compression gasoline? *At pumps marked "Ethyl"!* Ethyl is at least six octane numbers higher in anti-knock value than regular-grade gasoline. That's why it gives smooth, high-compression power, prevents harmful knock that overheats the engine and wastes gas and oil. Ethyl assures you of 100% performance—plus all-round quality that is *double-tested*—by the oil company and by the Ethyl Gasoline Corporation.

**GIVES YOU A BETTER
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STEAM at 440 lbs. per sq. in. and 700° Fahrenheit from 24 boilers drives the huge turbines. Here you see one of the control rooms, or "starting platforms," from which the "Queen Mary's" 200,000 horsepower is controlled.

FUEL mixture is compressed in the cylinders of the average modern cars to less than one-sixth its original volume. You need ETHYL to prevent "knock" under this HIGH COMPRESSION.



ETHYL GETS FULL POWER FROM HIGH COMPRESSION

WORLD'S CHAMPION HIGH-DIVER...

SOME OF HER TITLES: NATIONAL HIGH-DIVING CHAMPION (33 FT. TOWER)
FOR 4 YEARS... U.S. NATIONAL SPRINGBOARD CHAMPION
WINNER IN 3 OLYMPICS



"I put great emphasis on good digestion,"
says Dorothy Poynton Hill, Camel Smoker

"IT'S a long way down when I dive from the high board," Dorothy continues, "—you can see why I enjoy Camels 'for digestion's sake.'" Mealtimes (*right*), and between meals, too, Dorothy prefers Camel's mildness. "I've found that Camels never jangle my nerves, or upset my physical condition," she says. By speeding up the flow of digestive fluids and increasing alkalinity, Camels give digestion a helping hand.

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INFORMATION CLERK in Grand Central, New York. Ray Jones says: "Smoking Camels helps keep my digestion on the right track."



COWPUNCHER Hardy Murphy, from Oklahoma, says: "As a cowhand, I take what chuck I get and count on Camels to ease my digestion."

"JACK OAKIE'S COLLEGE"—A gala show with Jack Oakie in person! Benny Goodman's "Swing" Band! Hollywood comedians and singing stars! Tuesdays—8:30 pm E. S.T. (9:30 pm E. D. S.T.), 7:30 pm C. S.T., 6:30 pm M. S.T., 5:30 pm P. S.T., over WABC-CBS.



Camels are made from finer, **MORE EXPENSIVE TOBACCOS**—Turkish and Domestic—than any other popular brand.

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FOR DIGESTION'S SAKE—SMOKE CAMELS